Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon

U.S. GEOLOGICAL SURVEY
Open-File Report 79-695

Prepared in cooperation with the
U.S. BUREAU OF LAND MANAGEMENT

GROUND-WATER DATA IN THE BAKER COUNTY-NORTHERN MALHEUR COUNTY AREA, OREGON

By C. A. Collins

U.S. GEOLOGICAL SURVEY
Open-File Report 79-695

Prepared in cooperation with the
U.S. BUREAU OF LAND MANAGEMENT

1979

UNITED STATES DEPARTMENT OF THE INTERIOR
CECIL D. ANDRUS, Secretary
GEOLOGICAL SURVEY
H. William Menard, Director

For additional information write to:

U.S. GEOLOGICAL SURVEY
P.O. Box 3202
Portland, Oregon 97208

CONTENTS

	Page
Introduction	1
Previous investigations	1
Location and description of the area	2
General geology	2
Occurrence of ground water	4
Explanation of data	5
Well- and spring-numbering system	5
Records of wells and springs	6
Drillers' logs of wells	6
Hydrographs of observation wells	6
Chemical quality of ground water	8
References	8

ILLUSTRATIONS

			Page
Plate	1.	Well- and spring-location map-------------------------	In pocket
Figure	1.	Location of project area-------------------------------------	3
	2.	Well- and spring-numbering system------------------------------	5
	3.	Hydrographs of selected observation wells---------------------	7

TABLES

			Page
		Conversion factors---	v
Table	1.	Records of selected wells and springs------------------------	10
	2.	Drillers' logs of selected wells------------------------------	20
	3.	Source and significance of chemical constituents and physical characteristics----------------------------------	26
	4.	Chemical analyses of ground-water samples--------------------	27

Conversion factors for inch-pound system and International System Units (SI)

[For use of those readers who may prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this report are listed below:]

Multiply inch-pound units	By	To obtain metric unit
	Length	
inch (in.)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometers (km)
	Area	
acres	.4047	hectares (ha)
square miles (mi^2)	2.590	square kilometers (km^2)
	Volume	
acre-feet (acre-ft)	1233	cubic meters (m^3)
acre-feet (acre-ft)	.001233	cubic hectometers (hm^3)
cubic feet (ft^3)	.02832	cubic meters (m^3)
gallons (gal)	3.785	liters (L)
Mgal (million gallons)	3785	cubic meters (m^3)
	Specific combinations	
cubic feet per second (ft^3/s)	.02832	cubic meters per second (m^3/s)
gallons per minute (gal/min)	.06309	liters per second (L/s)
gallons per minute per foot [(gal/min)/ft]	.2070	liters per second per meter [(L/s)/m]
million gallons per day (Mgal/d)	3785	cubic meters per day (m^3/d)
	Temperature	
degrees Fahrenheit (°F)	5/9 after subtracting 32 from F° value	degrees Celsius (°C)

GROUND-WATER DATA IN THE BAKER COUNTY-NORTHERN MALHEUR COUNTY AREA, OREGON

--

By C. A. Collins

--

INTRODUCTION

Appraisals of the resources of selected management areas in eastern Oregon are being made by the U.S. Bureau of Land Management. To provide needed hydrologic information, the Bureau of Land Management requested the U.S. Geological Survey, Water Resources Division, to inventory ground-water data for the Baker County-northern Malheur County area. The inventory included field location of selected wells and springs; measurement of ground-water levels, temperatures, specific electrical conductance, and pH; and the collection of ground-water samples at selected localities to determine dissolved chemical constituents.

Included in this report are well data, drillers' lithologic logs, hydrographs, and chemical analyses of ground water.

Previous Investigations

The ground-water resources in several parts of the study area have been discussed in previous reports (Trauger, 1950; Ducret and Anderson, 1965; Price, 1967; Lystrom, Nees, and Hampton, 1967; Brown and Newcomb, 1962). Trauger's preliminary report on ground water in Baker Valley was updated by Ducret and Anderson (1965) and by Lystrom, Nees, and Hampton (1967). The report by Price (1967) is a generalized reconnaissance of the Burnt River valley, and the report by Brown and Newcomb (1962) describes the ground-water resources of the Cow Valley area. The areas covered by these studies are outlined on plate 1. Additional analyses of ground water are given in the report by Newcomb (1972).

Many reports describe the geology of parts of the study area; however, the "Geologic Map of Oregon East of the 121st Meridian" (Walker, 1977) covers the entire area. The geothermal resources of northern Malheur County have been studied by several agencies, and results of those studies provide additional data for that part of the area.

Hydrographs of water levels for representative wells in Oregon are published periodically by the Oregon Water Resources Department (formerly the Oregon State Engineer) (Sceva, 1964; Sceva and DeBow, 1965, 1966; Bartholomew and DeBow, 1967, 1970; Bartholomew and others, 1973).

Location and Description of the Area

The Baker County-northern Malheur County area is in eastern Oregon and includes most of Baker County, the northern third of Malheur County, and small parts of Grant and Harney Counties (fig. 1). The study area is one of the Bureau of Land Management environmental impact study areas in eastern Oregon. The northwestern boundary of the study area coincides with Baker and Grant County lines, but elsewhere the boundary does not follow natural, physical, nor political boundaries.

The project area is bounded on the north by the Wallowa Mountains, on the west by the Blue Mountains, on the south by the Malheur River between Juntura and Hope and thence southeast to the Snake River at Nyssa, and on the east by the Snake River. The principal drainage basins within the area are the Powder and Burnt Rivers and part of the Malheur River; all are tributaries of the Snake River. The study area exceeds 5,400 mi^2, and it includes land in both private and public ownership. The public land is managed by the Vale and Baker Districts of the Bureau of Land Management and by the U.S. Forest Service.

The population centers of the area are Baker and Ontario, with a combined population of 17,400 in 1976 (Oregon Secretary of State, 1977). Other incorporated towns include Haines, Halfway, Huntington, Nyssa, Richland, Sumpter, Unity, and Vale. The most densely populated areas are Baker Valley near Baker and Malheur River valley in the Vale-Ontario-Nyssa area; the remainder of the people live along other valleys of the area. The area is served by an interstate highway that runs from northwest to southeast, and a number of good highways radiate from the major population centers to the smaller communities. During summer and fall, much of the public land is accessible by seasonal roads.

The area has several wide alluvial valleys, such as Baker Valley, Malheur River valley, and the Oregon side of the Snake River valley, with smaller valleys along Willow and Cow Creeks and the Burnt River. Within a few miles, the terrain may change abruptly from a broad, flat valley floor (elevation 3,400 ft) to rugged mountains (elevation 9,100 ft) or to rolling hills that may rise only a few hundred feet above the valley floor.

General Geology

The geology of the study area is complex and varied. A broad band of metamorphosed intrusive rocks, such as granite and gabbro, limestone and argillite, and schist and metavolcanics, 15 to 25 miles wide, extends from northwestern to southeastern Baker County. These rocks also crop out in the uplands around Baker Valley, in the southern part of the Wallowa Mountains, and in the northwestern corner of Malheur County.

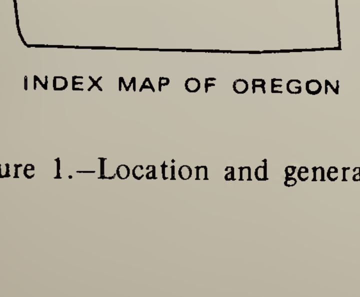


Figure 1.–Location and general features of the Baker County-northern Malheur County area, Oregon.

These rocks are overlain locally by volcanic flows, pyroclastics, and breccias. Principal outcrop areas are along Burnt River, south and east of Baker Valley, the western half of Malheur County, and in eastern Baker County. In places, these volcanic rocks extend beneath lowlands such as Cow Valley where they may be tapped by wells. Sediments, as much as 3,000 feet thick, overlie and are interbedded with the volcanic rocks. Those sediments are exposed in an area 15 to 20 miles on either side of Malheur River in eastern Malheur County, along the upper Burnt River valley, and south of Baker Valley. They also extend beneath the Snake and lower Malheur River valleys, Baker Valley, and other lowland areas. These sediments include sand and gravel, tuff, silt and clay, chalky limestone, and diatomite.

Alluvium forms the floor of Baker Valley and the valleys of all major streams. The alluvium consists of sand, gravel, silt, and clay, in varying proportions. Generally it is less than 50 feet thick, but may be 100 feet or more beneath Baker Valley, where it cannot be distinguished readily from the underlying sediments. Several streams, such as Burnt River, are bordered by discontinuous benches of terrace gravels, generally less than 30 feet thick.

Except for the alluvium, many of the rocks in the project area have been warped, folded, and faulted. Northwest-trending faults are common in the metamorphosed and intrusive rocks, whereas those in volcanic rocks and sediments are nearly north-south. Hot springs in the area are generally attributed to geothermally heated water rising along fault zones (Mariner and others, 1974, p. 17; Bowen and Blackwell, 1975, p. 111).

Occurrence of Ground Water

Large quantities of ground water are withdrawn by many wells from sand and gravel and from consolidated rock aquifers in the Baker, Cow, and Malheur River valleys. Wells in these areas produce as much as 2,000 gal/min, and the water is used chiefly for irrigation. The distribution of the consolidated rock aquifers beneath the valley-fill deposits is generally poorly known. Ground water in Baker and Cow Valleys is generally unconfined, although water in some of the deeper zones may be confined by rocks of low hydraulic conductivity such as clay or dense crystalline basalt. Many of the more productive wells obtain water from both the alluvium and underlying sediments or volcanic rocks.

Ground-water recharge in the uplands is chiefly by direct infiltration of precipitation, and locally along streams by infiltration of streamflow during periods of high runoff. Irrigation canals that border many of the stream valleys also lose water which recharges the alluvium. Upward movement of ground water from the underlying consolidated rocks may also provide small quantities of water to the valley-fill deposits.

The general direction of movement of ground water in the Baker County-northern Malheur County area is from upland recharge areas toward valley areas where the ground water is discharged by seepage to springs, by diffuse

seepage to streams, by evapotranspiration, or by wells. Evapotranspiration of shallow ground water probably is the cause of large areas of alkali soil in some of the valleys.

Locally in the Malheur and Willow Creek valleys, wells and springs yield warm, geothermally heated ground water, as discussed by Bowen and Peterson (1970); Mariner, Rapp, Willey, and Presser (1974); and Mariner, Presser, Rapp, and Willey (1975). Several warm springs in northern Malheur County were visited during this study, and data from them are listed in tables 1 and 4.

EXPLANATION OF DATA

Well- and Spring-Numbering System

Wells and springs are assigned a number based on their location according to the rectangular system for subdivision of public lands. In successive order, the numerals represent the township, range, and section. Thus, well 16S/43E-16dcc is in township 16 south, range 43 east, section 16. A graphic illustration of this method of well location is shown in figure 2. The letters following the section number show the location within the section, the first letter designating the quarter section (160 acres), the second letter the quarter-quarter section (40 acres), and the third letter the quarter-quarter-quarter section (10 acres). Where two or more wells are in the same 10-acre subdivision, serial numbers are added after the third letter. For a spring, a lower case (s) is appended to the final letter.

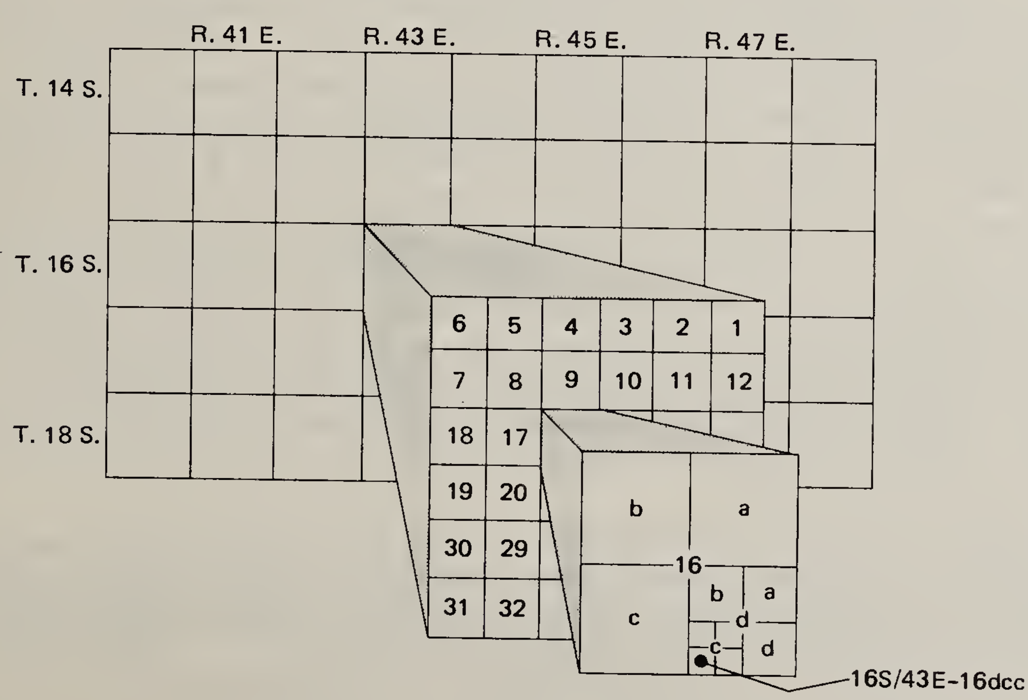


Figure 2.—Well and spring-numbering system.

Records of Wells and Springs

Records of wells and springs in the Baker County-northern Malheur County area are listed in table 1. Well records have been published for Baker Valley (Trauger, 1950; Ducret and Anderson, 1965), Burnt River valley (Price, 1967), and the Cow Valley area (Brown and Newcomb, 1962). In the area outside those report areas, many of the wells for which drillers' logs are available have been field located, and their locations are shown on plate 1. One exception is the Vale-Ontario-Nyssa area, where most of the land is in agricultural use but the water used for irrigation is supplied by surface water. Most of the field-located wells were plotted on Geological Survey 1:24,000-scale quadrangle maps, and the maps are on file in the Geological Survey Oregon District office. Table 1 also includes some data on selected springs; wherever possible, the discharge of the spring was measured at the time of the visit. Little or no data were available, however, for estimating fluctuations in the discharge of those springs.

Drillers' Logs of Wells

Drillers' logs of wells are obtained from reports submitted by drillers to the Oregon Water Resources Department since 1956 and from records supplied by the Bureau of Land Management. Drillers' terminology for the materials penetrated, which varies from driller to driller, is used in table 2. The logs have been edited so that lithology is given first.

Hydrographs of Observation Wells

Hydrographs in figure 3 show fluctuations of ground-water levels in six representative observation wells in the study area. The period of record for two of the wells extends from 1950 and 1955 to the present (1979), and the other four are for shorter periods. Ground-water levels generally rise each year when the ground-water reservoir is recharged and ground-water storage is increased. Water levels decline during periods of no recharge as ground-water storage decreases. If, over a period of time, ground-water discharge exceeds the rate of recharge, water levels gradually decline and the hydrographs show a declining trend. Conversely, a rising trend occurs when ground-water recharge exceeds ground-water discharge. In most of the study area neither rising nor declining trends are apparent, and ground-water levels are more or less stable. This suggests that ground-water recharge and discharge in the area generally are in balance.

Hydrographs of observation wells in the Cow Valley area show continuing declining trends, although ground-water pumpage has been restricted by an order of the State Engineer (now Oregon Water Resources Department) since 1959. (See fig. 3, well 15S/40E-13acc.)

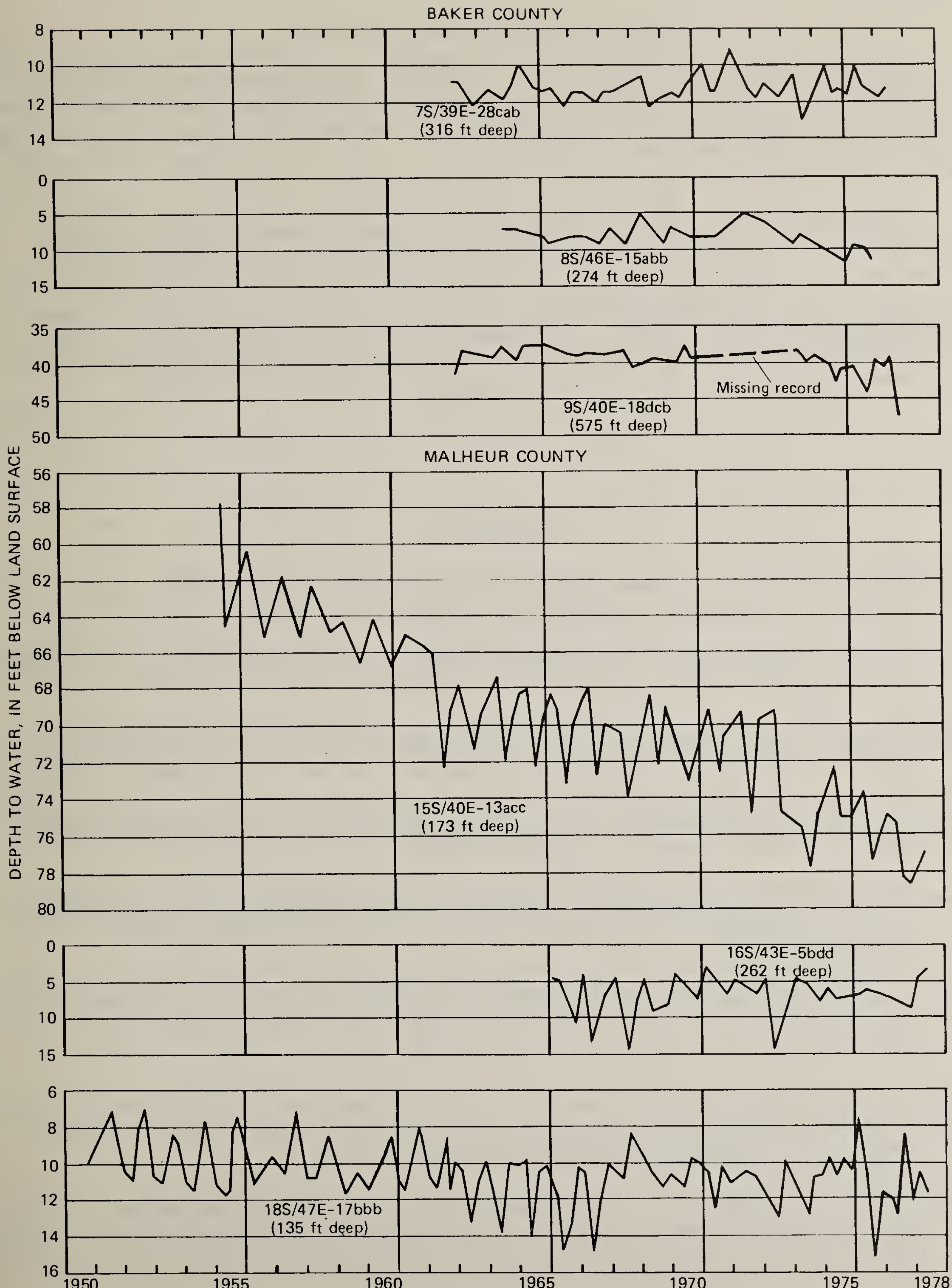


Figure 3.–Hydrographs of selected observation wells.

Chemical Quality of Ground Water

Chemical analyses were made by the Geological Survey of 16 ground-water samples from the Baker County-northern Malheur County area. Selected analyses of water from other wells are provided from previous reports to give more complete water-quality information for the area. (See those reports for water analyses not reported here.)

The specific electrical conductance of a water sample measures the ability of water to conduct an electrical current and is related to the concentration of the dissolved constituents. Specific conductance ranged from 52 to 2,130 micromhos per centimeter at 25°C, sulfate from 2.3 to 680 mg/L, fluoride from 0.1 to 9.8 mg/L, and arsenic from 0.001 to 0.317 mg/L. The source and significance of the chemical constituents and physical properties are summarized in table 3, and the analyses are listed in table 4.

REFERENCES

Bartholomew, W. S., and DeBow, Robert, 1967, Ground water levels, 1966: Oregon State Engineer Ground-Water Report 12, 122 p.

________1970, Ground water levels, 1967-1968: Oregon State Engineer Ground Water Report 15, 122 p.

Bartholomew, W. S., Graham, M. E., and Feusner, John, 1973, Ground water levels, 1968-1972: Oregon State Engineer Ground Water Report 18, 134 p.

Bowen, R. G., and Blackwell, D. D., 1975, The Cow Hollow geothermal anomaly, Malheur County, Oregon: Ore Bin, v. 37, no. 7, p. 109-121.

Bowen, R. G., and Peterson, N. V., 1970, Thermal springs and wells in Oregon: Oregon Department of Geology and Mineral Industries Miscellaneous Paper 14.

Brown, S. G., and Newcomb, R. C., 1962, Ground-water resources of Cow Valley, Malheur County, Oregon: U.S. Geological Survey Water-Supply Paper 1619-M, 38 p.

Ducret, G. L., Jr., and Anderson, D. B., 1965, Records of wells, water levels, and chemical quality of water in Baker Valley, Baker County, Oregon: Oregon State Engineer Ground Water Report 6, 34 p.

Lystrom, D. J., Nees, W. L., and Hampton, E. R., 1967, Ground water of Baker Valley, Baker County, Oregon: U.S. Geological Survey Hydrologic Investigations Atlas HA-242.

Mariner, R. H., Presser, T. S., Rapp, J. B., and Willey, L. M., 1975, The minor and trace elements, gas and isotope composition of the principal hot springs of Nevada and Oregon: U.S. Geological Survey open-file report, 27 p.

Mariner, R. H., Rapp, J. B., Willey, L. M., and Presser, T. S., 1974, The chemical composition and estimated minimum thermal reservoir temperatures of selected hot springs in Oregon: U.S. Geological Survey open-file report, 32 p.

Newcomb, R. C., 1972, Quality of the ground water in basalt of the Columbia River Group, Washington, Oregon, and Idaho: U.S. Geological Survey Water-Supply Paper 1999-N, 71 p.

Oregon Secretary of State, 1977, Oregon Blue Book 1977-1978, edited by Berylalee Winningham: State of Oregon, 337 p.

Price, Don, 1967, Ground-water reconnaissance in the Burnt River valley area, Oregon: U.S. Geological Survey Water-Supply Paper 1839-I, 27 p.

Sceva, J. E., 1964, Ground water levels, 1963: Oregon State Engineer Ground Water Report 4, 71 p.

Sceva, J. E., and DeBow, Robert, 1965, Ground water levels, 1964: Oregon State Engineer Ground Water Report 5, 109 p.

________1966, Ground water levels, 1965: Oregon State Engineer Ground Water Report 9, 111 p.

Trauger, F. D., 1950, Ground-water resources of Baker Valley, Baker County, Oregon: U.S. Geological Survey open-file report.

U.S. Environmental Protection Agency, 1976 [1977], Quality criteria for water: U.S. Government Printing Office, Washington, D.C., 256 p.

Walker, G. W., 1977, Geologic map of Oregon east of the 121st meridian: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-902.

Table 1.--Records of selected wells and springs

Well or spring number: See page 5 for description of well- and spring-numbering system.
Depth of casing: Depth of casing indicates total length of casing.
Finish: P, perforated; X, open hole; O, open end; S, screened.
Character of material: Character of material refers to water-bearing formations as reported by driller.
Altitude: Altitude of land surface at well, in feet above mean sea level, interpolated from topographic maps, generally to the nearest 1 foot.
Water level: Depths to water below land surface given in feet and decimals were measured by personnel of the Geological Survey or the Oregon Water Resources Department; those given in whole feet were reported by well driller or owner. F, flowing well whose static water level is not known.

Temperature: In some cases, water temperature at time of visit may not be representative of aquifer temperature.
Use: C, commercial; H, domestic; I, irrigation; P, public supply; R, recreational; S, stock; U, unused.
Remarks: Ca, chemical analysis reported in table 4; L, driller's log in table 2. B, bailed; P, pumped; At, test pumped using compressed air for indicated time to determine yield under "Well performance." Obs, observation well whose water level is measured periodically. 1/ Information taken from Ducret and Anderson (1965); 2/ information taken from Price (1967); 3/ information taken from Brown and Newcomb (1962).

Well or spring number	Owner	Year completed	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Finish	Character of material	Altitude (feet)	Water level: Feet below datum	Water level: Date	Specific conductance of water	Temperature (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Use	Remarks
							Baker County									
							T. 6 S., R. 48 E.									
3dba(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	3,960	--	--	109	11.1	--	--	S	Flowing 0.2 gal/min 11-8-78.
15adc	Maynard	1968	115	6	22	X	Rock	1,760	48.6	11- 8-78	245	13	5	50	H	L, B 1 hr.
15dac	Dan Cole	1962	107	8	22	X	"Diorite"	1,660	58	9- 4-62	--	--	11	25	H	B 1 hr.
							T. 7 S., R. 39 E.									
3abb	L. H. Williams	--	237	12	--	--	--	3,320	28.60	11-17-78	--	--	--	--	U	Obs.
20ccb	City of Baker	--	9	12	7	P, 3-7	Sand and gravel	3,374	3.62	do	--	--	--	--	U	Do.
28cab	Martha Traverso	1954	316	10	316	--	--	3,320	11.50	do	--	--	1,000	--	I	Obs. 1/.
							T. 7 S., R. 46 E.									
33dcb	Lester LaRue	1967	477	6	27	X	Rock	2,790	158.5	11- 9-78	118	11.2	15	50	H	L, B 3 hr.
							T. 7 S., R. 48 E.									
4cbc	O. S. Elliot	1975	105	6	27	X	Rock	1,760	29.15	11- 8-78	--	--	8	--	H	L, P 8 hr.
							T. 8 S., R. 39 E.									
22bdd	Baker County	1936	12	12	11	P, 7-11	Sand and gravel	3,386	4.30	11-17-78	320	--	--	--	U	Obs, Ca. 1/.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year completed	Depth of well (feet)	Diameter of well (inches)	Depth of casing (feet)	Finish	Character of material	Altitude (feet)	Water level: Feet below datum	Water level: Date	Specific conductance of water	Temperature (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Use	Remarks
							Baker County--Continued									
							T. 8 S., R. 40 E.									
14adb	Frank Tetrault	1969	102	12	102	P, 8-102	--	3,355	0.07	11-17-78	--	--	550	30	I	Obs.
							T. 8 S., R. 41 E.									
14abd	Steward-Morrissey, Inc.	1963	685	14	685	P, 0-685	Lava, rock, and cinders	2,795	34.00	3-16-73	--	--	1,560	50	I	Obs, L. 1/.
34cba	U.S. Bureau of Land Management	1974	420	6	398	P, 320-398	Basalt	3,700	319	8- 8-74	--	13	15	31	S	L, At 4 hr. Four Corners well.
							T. 8. S., R. 42 E.									
33abc	U.S. Bureau of Land Management	1962	325	6	315	X	Basalt	2,981	237.08	11-12-78	--	--	5	--	S	L. Later deepened to 330 ft. Cilkison well.
							T. 8 S., R. 46 E.									
8cdd	City of Halfway	--	--	--	--	--	--	2,685	24.01	11- 9-78	--	--	--	--	P	Standby well, reported to be 285 ft deep.
8dcb	do	1971	300	12	259	P, 78-259	Sand and gravel	2,680	45	7- 7-71	--	--	300	38	P	L, P 4 hr.
15abb	Lewis Laird	1963	275	8	274	P, 124-144, 164-274	do Clay and gravel	2,560	8.90	7- 20-78	--	--	600	100	I	L, Obs, P 2 hr. Deepened from 140 ft 10-3-63.
21aac	U.S. Forest Service	1959	268	6	268	P, 95-264	Clay, sand, and gravel	2,555	11	1-29-59	--	--	260	54	P	
21abb	Ellingson Lumber Co.	1965	307	12	307	P, 30-307	do	2,570	16.78	10-10-78	--	--	590	130	U	L, P 8 hr.
							T. 9 S., R. 39 E.									
2ccc	Kermit Hansen	--	321	12	321	P, 0-321	Sand and gravel	3,420	10.48	11-17-78	350	--	--	--	U	Obs, Ca. 1/.
							T. 9 S., R. 40 E.									
1ccb	Arlie Patton	1956	132.5	10	131	P, 1-131	Clay, sand, and gravel	3,460	24.00	9-28-78	--	--	100	0	I	Obs. 1/.
18dcb	P. V. Hill	1955	575	12	575	0	Clay, "soapstone," and "granite"	3,475	39.65	11-17-78	--	--	1,100	166	I	Obs, Ca. 1/.
							T. 9 S., R. 41 E.									
2acd	U.S. Bureau of Land Management	1940	229	6	--	--	--	3,480	167.28	11-12-78	--	--	--	--	S	L. Hogg well.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year com-pleted	Depth of well (feet)	Diameter of well (feet)	Depth of casing (feet)	Finish	Character of material	Alti-tude (feet)	Water level: Feet below datum	Water level: Date	Specific conduct-ance of water	Temper-ature (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Use	Remarks
							Baker County--Continued									
							T. 9 S., R. 41 E.--Continued									
3acc	U.S. Bureau of Land Management	1974	495	6	20	X	Basalt	3,635	268	8-12-74	--	13	3	227	S	P 2 hr. Staggs-Green well. Recently produced only 1 gal/min.
10dcd	do	1974	160	6	160	O	--	3,370	100	8-13-74	--	13	5	55	S	At 1 hr. Virtue Flats well. Originally 225 ft deep. Recently produced only 1½ gal/min.
20acb	do	1962	196	6	21	X	Lava rock and black sand	4,220	193.15	11- 7-78	--	--	4	8	S	P 2 hr. Williams well. Originally static water level was 181 ft.
21bbd	Dave Williams	--	210	4	210	O	do	3,820	199.80	do	--	--	--	--	U	Depth and casing data questionable.
							T. 9 S., R.									
27dcd	U.S. Bureau of Land Management	1964	218	6	44	X	Coarse sand	3,910	198	7- 5-64	--	--	5	0	S	L, B 1 hr. Benny's well. Reported to be dry 1977-78.
28ada	do	1963	256	4	256	O	Clay and fine sand	3,880	156	7- 2-63	--	--	3	145	S	L, P 4 hr. Williams well No. 2.
							T. 9 S., R. 42 E.									
3ddc	U.S. Bureau of Land Management	1974	316	6	316	P, 0-40, 200-220, 276-316	--	3,000	95	9-23-74	--	--	3	65	S	P 2 hr. Bulldozer well.
6bbb	do	1975	362	4	338	P, 238-338	Rock	3,245	262	12-30-74	--	--	5	78	S	P 1 hr. Staggs-Weber well.
16dba	do	1974	283	4	283	O	Clay and gravel	3,391	184.02	11-11-78	--	--	8	50	S	L, B 1 hr. Ritter well.
							T. 9 S., R. 44 E.									
6bba(s)	Oregon Department of Transportation, Highway Division	--	--	--	--	--	--	2,560	--	--	340	11.4	--	--	U	Flowing 8½ gal/min on 11-11-78. J. N. Bishop Spring.
							T. 9 S., R. 45 E.									
13cbc	W. E. Graven	1973	30	6	30	O	Sand and gravel	2,260	20	12-12-73	--	--	20	6	H	P 2 hr.
14daa	Vern DuMars	1976	233	6	225	P, 150-160, 180-190, 205-225	Clay, sand, and gravel	2,280	47	4-11-76	--	--	3	90	U	L, B 2 hr.
14dba	do	1976	57	6	56	P, 37-54	Sand and gravel	2,250	22	4-30-76	420	13	35	10	H,S	Do.
17cdd	Earl Baker	1975	270	6	129	X	Basalt	2,580	35	11-10-75	950	11.3	10	115	S	L, P 2 hr.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year com-pleted	Depth of well (feet)	Diameter of well (feet)	Depth of casing (feet)	Finish	Character of material	Alti-tude (feet)	Water level: Feet below datum	Water level: Date	Specific conduct-ance of water	Temper-ature (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Use	Remarks
							Baker County--Continued									
							T. 10 S., R. 41 E.									
24ddb	E. B. Dunham	1971	128	6	35	X	Clay	3,760	19	8-20-71	--	--	7	96	H	B 1 hr.
24ddc	Ron Ahern	1971	130	6	42	X	do	3,755	18	8-19-71	--	--	5	107	H	L.
							T. 10 S., R. 42 E.									
6acc(s)	Mrs. Effie Wellman	--	--	--	--	--	--	4,180	--	--	61	0.5	--	--	S	
							T. 11 S., R. 43 E.									
20ddb	Clarance Pearce	1973	130	6	20	X	Sand	2,670	23	4- 7-73	--	--	8	100	H	L, B 1 hr. A 150-ft well nearby produced 2½ gal/min with 122 ft of drawdown.
21cbd	Gerald Pickler	1970	125	6	25	X	Sandy shale	2,700	30	6- 6-70	--	--	8	90	H	B 1 hr.
28acc	Rod McCullough	1977	270	6	265	P, 50-60, 245-265	Clay	2,670	36	9- 4-77	--	--	60	30	P	L, P 5 hr.
28bbb	Sem Cordell	1971	87	6	42	X	Sandy shale	2,680	24	8-13-71	--	--	5	51	H	B 1 hr.
36dbd	D. D. Ewart	1975	50	6	33	P, 24-33	Sand and gravel	2,920	18	7-29-75	--	--	30	2	H	L, B 1 hr.
							T. 12 S., R. 37 E.									
28bdb	Oregon Department of Transportation, Highway Division	1974	140	6	40	X	Sandstone	3,865	60	4-15-74	--	--	24	6	R	L, B 1 hr. Unity Reservoir State Park.
							T. 12 S., R. 38 E.									
27aab	John Mann	1959	81	6	81	O	Clay, sand, and gravel	3,660	41.45	9-26-78	683	14	22	5	H	Obs, Ca. 2/.
							T. 12 S., R. 43 E.									
11bda	Oregon Portland Cement Co.	1977	56	8	56	O	Sand and gravel	2,550	17	7-18-77	640	11.5	300	24	N	L, B 1 hr, Ca.
							T. 12 S., R. 44 E.									
30add	Oregon Department of Transportation, Highway Division	1967	34	8	24	P, 19-24	Gravel	2,410	5	7-11-67	--	--	80	9	R	L, P 3 hr. New 130-ft well 50 ft north of present well produced 4 gal/min.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year completed	Depth of well (feet)	Diameter of well (feet)	Depth of casing (feet)	Finish	Character of material	Altitude (feet)	Water level: Feet below datum	Water level: Date	Specific conductance of water	Temperature (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Use	Remarks
Baker County--Continued																
T. 13 S., R. 37 E.																
17acd	Unity School District 30J	--	330	--	--	--	--	4,010	14.7	9-26-78	--	--	--	--	U	Obs.
T. 13 S., R. 44 E.																
27ddb	Oregon Portland Cement Co.	1965	137	8	105	X	Rock	2,240	42	10-25-65	--	--	15	40	H	L, P 20 hr. Reported to have high iron content.
T. 14 S., R. 45 E.																
5cdb(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	2,150	--	--	410	14.9	--	--	R	Spring Recreation Area.
32daa	Oregon Department of Transportation, Highway Division	1970	125	6	63	P, 42-54	Gravel	2,120	36.18	11-13-78	840	13.9	10	69	R	L, P 28 hr. Farewell Bend State Park.
Malheur County																
T. 14 S., R. 39 E.																
21bdd	Donald Oaks	1961	734	12	161	P, 20-160	Gravel	3,750	16.98	11- 9-78	--	--	700	140	I	Obs, P 8 hr.
21dcd	Mary Molthan	--	320	--	--	--	Sand and gravel	3,770	26.67	do	--	--	--	--	I	Obs.
29baa	John Molthan	1951	1,290	12	152	P, 25-150	do	3,795	4.70	do	--	--	300	100	I	L, P 4 hr, Obs.
29bcd	do	1960	980	12 10	119	P, 50-119, 200-500	do	3,860	38.15	do	--	--	150	125	I	P 2 hr, Obs.
32ada	Ray Duncan	--	998	12	--	--	do	3,827	7.78	do	--	24	700	165	I	P 6 hr, Obs.
T. 15 S., R. 40 E.																
1bad	Mrs. W. E. Anderson	1953	330	14	300	P, 180-245, 275-290	Sand, gravel, and lava	3,973	117.14	11- 9-78	--	--	1,200	70	I	Obs. 3/.
2ccb	Rankin Crow	1950	310	10	170	P, 80-170	Sand and gravel	3,915	57.46	do	293	12	251	40	I	P 3 hr, Obs, Ca. Crow well No. 2. 3/.
2daa	Max Holloway	1949	421	12	55	X	Sand, gravel, and lava	3,898	42.39	do	318	12	1,000	31	I	P 8 hr, Obs, Ca. Holloway well No. 1. 3/.
10dbc	Rankin Crow	1952	1,000	14	100	P, 60-100	Gravel and volcanic rock	3,936	73.87	do	382	24	580	121	I	P 1 hr, Obs, Ca. Crow well No. 9. 3/.
11cdb	do	1950	200	12	128	P, 40-128	do	3,923	64.31	do	465	14	800	120	I	P 2½ hr, Obs, Ca. Crow well No. 4. 3/.
13bba	Guss Davis	1954	300	14	162	P, 50-155	Sand, gravel, and cinders	3,910	53.43	do	328	--	900	--	I	L, Obs, Ca. Davis well No. 1. 3/.
14dcb	Rankin Crow	1951	248	14	157.5	--	Volcanic cinders	3,969	111.12	do	304	15	2,500	45	I	P ½ hr, Obs, Ca. Crow well No. 8. 3/.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year completed	Depth of well (feet)	Diameter of well (feet)	Depth of casing (feet)	Finish	Character of material	Altitude (feet)	Water level		Specific conductance of water	Temperature (°C)	Well performance		Use	Remarks
									Feet below datum	Date			Yield (gal/min)	Drawdown (feet)		
							Malheur County--Continued									
							T. 15 S., R. 41 E.									
8cbc	Rankin Crow	1951	360	12	100	--	Gravel	3,920	64.86	11-10-77	264	19	1,880	--	I	Obs, Ca. Crow well No. 6. 3/.
							T. 15 S., R. 42 E.									
25aba	Mark Velsmeyer	1960	560	10	34	P, 30	Gravel	2,600	3.89	11- 8-78	--	--	400	200	I	P 10 hr, L, Obs.
							T. 15 S., R. 44 E.									
25cac(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	2,532	--	--	540	16.5	--	--	S	Flowed 2 gal/min 8-31-78. Beirman Spring.
29bba(s)	do	--	--	--	--	--	--	2,870	--	--	415	26	--	--	S	Flowed 10½ gal/min 8-31-78. Mud Spring.
33daa(s)	do	--	--	--	--	--	--	2,667	--	--	525	21	--	--	S	Flowed 12½ gal/min 8-31-78. McDowell Spring.
36cdd(s)	do	--	--	--	--	--	--	2,705	--	--	750	14	--	--	S	Flowed 2½ gal/min 8-31-78. McCarthy Spring.
							T. 15 S., R. 45 E.									
4cbb	Clyde Ramsey	1970	645	8	607	P, 27-607	Sand and gravel	2,112	31.15	10-29-78	--	--	20	150	C	P 12 hr, L. Originally drilled to 303 ft.
							T. 15 S., R. 47 E.									
29ada	H. B. French	1977	30	6	29	P, 21-24	Sand and gravel	2,101	7.14	10-27-78	1,220	14	10	7	H	L, B 2 hr.
30dda	Harry Frazier	1968	40	16	39	P, 21-39	do	2,099	6.08	do	--	--	440	24	I	L, P 4 hr.
							T. 16 S., R. 42 E.									
31ddd(s)	Michael Carroll	--	--	--	--	--	--	4,960	--	--	55	12	--	--	S	Boston Horse Camp Spring.
							T. 16 S., R. 43 E.									
5bdd	Estel Moser	1965	262	12	40	P, 18-40	Sand and gravel	2,530	[illegible].45	11- 8-78	--	--	1,080	100	I	L, P 1 hr, Obs.
16dcc	Ralph Altig	1952	930	12	50	X	Basalt	2,620	33.51	do	--	--	--	--	I	Obs.
							T. 16 S., R. 45 E.									
7bdc1	U.S. Bureau of Land Management	1976	125	6	118	P, 97-118, S, 111-118	Clay and sand	2,720	82.68	8-31-78	1,120	--	27	3	S	L, P 4 hr, Ca. New Redsull well.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year com-pleted	Depth of well (feet)	Diameter of well	Depth of casing (feet)	Finish	Character of material	Alti-tude (feet)	Water level: Feet below datum	Water level: Date	Specific conduct-ance of water	Temper-ature (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Use	Remarks
							Malheur County--Continued									
							T. 16 S., R. 45 E.--Continued									
7bdc2	U.S. Bureau of Land Management	--	--	--	--	--	--	2,718	--	--	870	15.2	--	--	S	Ca. Well reported to be 100 ft deep. Old Redsull well.
10dcc	do	--	--	--	--	--	--	2,770	--	--	750	17.0	--	--	S	Ca. Well reported to be 100 ft deep. Linkous well.
							T. 16 S., R. 46 E.									
26dac	Hyline Ranch	1971	606	8	21	X	"Rock sand" and rock	2,757	200.5	10-28-78	545	19.0	15	100	S	L, B 2 hr.
							T. 16 S., R. 47 E.									
16bdd	Tom Uriu	1968	75	6	59	P, 54-59	Sand and gravel	2,178	19.26	10-29-78	890	16.7	30	5	H	B 2 hr, Ca.
17abc	Robert Lucas	1977	410	6	100	P, 80-100	Sandy clay	2,370	50.10	10-28-78	1,190	14.5	5	240	H	L, P 1 hr.
35dab	Charles Degitz	1972	63	6	59	P, 54-59	Sand and gravel	2,170	23	4- 1-72	1,000	14.5	30	7	H	L, P 4 hr.
35dbd1	Lloyd Campbell	1978	70	6	--	--	Sand	2,175	29.03	10-28-78	980	13.0	--	--	H	
35dbd2	do	1970	70	6	45	X	Sand and gravel	2,177	32	5-18-70	--	--	6	28	--	B 1 hr. Well went dry; has been destroyed.
							T. 17 S., R. 42 E.									
5aba(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	4,930	--	--	75	14.3	--	--	S	Flowing ½ gal/min 9-28-78. Buck Spring.
							T. 17 S., R. 44 E.									
11dba	John Stringer	1970	1,300	14	--	--	--	2,360	31.52	11- 8-78	--	--	--	--	I	Obs. Deepened from 400 ft.
25ada	C. N. Durrett	1947	73	12	--	--	Sand and gravel	2,340	44.24	do	--	--	--	--	I	Obs.
							T. 17 S., R. 45 E.									
2ccb	U.S. Bureau of Land Management	1975	650	6	650	P, 588-650	Clay	2,580	135	4- 4-75	1,734	24.8	15	265	S	P 7 hr, Ca. Alkali Gulch well.
							T. 17 S., R. 47 E.									
7add	Warren Willison	1970	145	6	141	P, 135-141	Sand and gravel	2,380	91	7-23-70	805	12.5	20	20	H	P 2 hr.
10acc	George Duerr	1977	65	12	30	P, 20-30	do	2,132	10	1-29-77	1,180	13.0	250	21	H	P 4 hr, L.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year com-pleted	Depth of well (feet)	Diameter of well	Depth of casing (feet)	Finish	Character of material	Alti-tude (feet)	Water level: Feet below datum	Water level: Date	Specific conduct-ance of water	Temper-ature (°C)	Well performance: Yield (gal/min)	Well performance: Draw-down (feet)	Use	Remarks
Malheur County--Continued																
T. 18 S., R. 37 E.																
34dac(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	3,480	--	--	320	15.6	--	--	S	Ga. Flowing about 1 gal/min 9-26-78. Greenspot Spring.
T. 18 S., R. 41 E.																
8dca	R. G. Stewart	1960	280	12	54	P, 25-52	Gravel	3,030	18	2-12-60	--	--	300	50	I	L, P 4 hr, Obs.
T. 18 S., R. 42 E.																
4cbb	R. L. Jordon	--	--	--	--	--	--	3,435	119.14	9-28-78	--	--	--	--	I	
T. 18 S., R. 43 E.																
9bbc(s)	R. L. Jordon	--	--	--	--	--	--	2,640	--	--	730	62.0	--	--	U	Ga. Neal Hot Spring.
T. 18 S., R. 44 E.																
18aca	Paul Fleming	1961	730	12	54	P, 35-50	Gravel	2,435	30.23	11-13-78	--	--	310	120	I	P 6 hr, Obs.
T. 18 S., R. 45 E.																
21bbc	K. T. Loomis	1960	140	12	40	P, 10-40	Sand and gravel	2,235	9.06	5-23-78	--	--	350	12	I	L, P 3½ hr, Obs.
T. 18 S., R. 46 E.																
9bdd	R. W. Metlen	1977	303	6	40	X	Sand	2,290	14.03	10-27-78	390	16.8	20	135	H	L, P 4 hr, Ca.
19cca	Glen Hutchinson	1961	435	16	28	P, 18-28	Sand and gravel	2,210	10.96	5-23-78	--	--	500	85	I	P 4 hr, Obs.
23dcc	Kay Teramura	1958	240	14	54	P, 21-52	do	2,250	15.32	do	--	--	580	41	I	Do.
T. 18 S., R. 47 E.																
2cdd	City of Ontario	1969	51	16	50	S, 26-40	Sand and gravel	2,138	5	8- 1-69	--	--	1,300	27	P	L, P 10½ hr. Well No. 6.
6bad	Harold French	1972	150	6	25	X	Sand	2,153	11	4-19-72	900	14.5	12	44	H	B 1½ hr.
9dbd	Treasure Valley Community College	1968	100	16	33	P, 21-33	Sand and gravel	2,150	16	5-18-68	760	14.7	400	64	I	L, P 15½ hr.
11baa	City of Ontario	1961	50	16	30	P, 29-30, S, 30-40	do	2,138	5.64	10-29-78	--	--	1,000	27	P	L, P 5½ hr, Ga. Well No. 4.
11bda1	do	1961	80	16	80	P, --	do	2,140	9	1-16-79	553	16	400	28	P	Ga. Well No. 1.
11bda2	do	1957	78	16	78	P, --	Sand	2,140	9	do	1,010	17.5	550	28	P	Ga. Well No. 3.
16bbb	Harry Okita	1952	145	12	87	P, 30-50	Gravel	2,175	14	10-25-52	--	--	750	55	U	P 8 hr.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year completed	Depth of well (feet)	Diameter of well	Depth of casing (feet)	Finish	Character of material	Altitude (feet)	Water level: Feet below datum	Water level: Date	Specific conductance of water	Temperature (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Use	Remarks
Malheur County--Continued																
T. 18 S., R. 47 E.--Continued																
17bbb	Earl Weaver	--	135	3	--	--	--	2,160	11.65	5-23-78	--	--	--	--	U	Obs.
19dbb	Ray Winegar	1975	61	6	62	P, 55-60	Gravel	2,203	22	3-30-75	1,320	14.0	20	9	H	B 1 hr.
19dbd	Ray Hasebe	1972	60	6	59	P, 53-58	Sand and gravel	2,203	17.98	10-26-78	--	--	20	13	H	Do.
T. 19 S., R. 38 E.																
30dcc(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	5,200	--	--	196	16.2	.02	--	S	Flowing < 0.1 gal/min 9-27-78. Barrel Spring.
T. 19 S., R. 39 E.																
19dab(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	5,130	--	--	140	9.6	--	--	S	Ca. Flowing 3/4 gal/min 9-28-78. Pole Creek Spring.
29acc(s)	do	--	--	--	--	--	--	5,480	--	--	90	9.0	--	--	S	Flowing 3 gal/min 9-28-78. Buckaroo Spring.
34cdc(s)	do	--	--	--	--	--	--	5,460	--	--	47	7.8	--	--	S	Flowing 1 gal/min 9-28-78. Buckboard Spring.
36bca(s)	do	--	--	--	--	--	--	4,800	--	--	73	13.8	--	--	S	Flowing 3/4 gal/min 9-28-78. Rimrock Spring.
T. 19 S., R. 42 E.																
35bbb	J. E. O'Toole	1956	100	12	18	P, 12-18	Sand and gravel	2,470	5.35	11-13-78	--	--	200	10	I	L, P 8 hr, Obs.
T. 19 S., R. 43 E.																
2cbc	Trenkel Bros.	--	198	--	--	--	--	2,345	F	11-13-78	--	--	--	--	I	Obs.
3bca	F. C. Vaughn	1961	690	6	38	P, 30-37	"Sand rock"	2,355	6.26	do	--	--	600	120	I	L, P 10 hr, Obs.
3dba	do	--	485	6	--	--	--	2,348	10.87	do	--	--	--	--	H	Obs.
10ada	T. J. Davis	--	85	12	--	--	--	2,365	36.78	do	--	--	--	--	I	Do.
22dda	U.S. Bureau of Land Management	1965	718	6	718	P, 678-718	Sand and gravel	2,968	545	4-18-65	715	29.5	15	45	S	L, P 12 hr, Ca. Vines Hill well.
T. 19 S., R. 45 E.																
5bbb	U.S. Bureau of Land Management	1975	92	6	27	P, 21-27	Sand and gravel	2,262	7.58	9-27-78	1,720	14.9	30	5	S	L, B 4 hr, Ca. New North Harper well.
9dbb	do	1964	696	6	696	P, 596-696	Clay and sand	2,820	569	5- 9-64	--	--	6	20	U	L, B 4 hr. North Harper well; no longer in use.

Table 1.--Records of selected wells and springs--Continued

Well or spring number	Owner	Year completed	Depth of well (feet)	Diameter of well	Depth of casing (feet)	Finish	Character of material	Altitude (feet)	Water level: Feet below datum	Water level: Date	Specific conductance of water	Temperature (°C)	Well performance: Yield (gal/min)	Well performance: Drawdown (feet)	Use	Remarks
Malheur County--Continued																
T. 19 S., R. 45 E.--Continued																
11bcc	U.S. Bureau of Land Management	1955	494	6	--	--	--	2,865	318.05	9-26-78	--	--	--	--	U	Needham well.
28acb	do	1969	620	6	620	P, 540-620	Sand and gravel	2,845	435	9-19-69	374	28.6	12	67	S	L, B 2½ hr, Ca.
T. 19 S., R. 46 E.																
4dba	Roger Findley	1977	445	12	210	P, 150-210	Sand	2,622	330	8-15-78	980	24.0	1,300	55	I	L, Ca.
18dba	Unknown	--	--	8	--	--	--	2,770	497.80	9-26-78	--	--	--	--	U	
21bad	Albertson's Land & Cattle Co.	1975	572	12	572	S, 384-394, 412-432	Sandstone, sand, and gravel	2,625	398.35	10-24-78	730	26.0	360	140	S	L, P 14 hr. Production reported to have dropped 80 gal/min.
T. 19 S., R. 47 E.																
8acc	Clarence Hart	1967	145	16	110	P, 27-47, 70-110	Sand and gravel	2,181	22.49	10-25-78	1,250	13.0	586	96	I	L, P 12 hr.
17ddd	Albertson's Land & Cattle Co.	1970	175	24	82	P, 30-82	do	2,165	7.79	do	850	14.7	595	100	I	L, P 4 hr, Ca.
18ddc	Robert Kiesel	1972	57	12	46	P, 26-46	do	2,189	12	3-18-72	1,120	13.0	325	36	D	P 8 hr.
28ccb	American Fine Foods	1964	562	--	--	--	do	2,172	9	6- 3-64	--	--	200	5	--	B 2 hr. Test hole; abandoned.
T. 20 S., R. 37 E.																
32acb(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	3,750	--	--	500	19.0	--	--	S	Flowing <0.1 gal/min 9-26-78. Chitsey Spring.
T. 20 S., R. 38 E.																
10bcd(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	4,160	--	--	190	15.5	--	--	S	Flowing ½ gal/min 9-27-78. Dishrag Spring.
T. 20 S., R. 39 E.																
2cbc(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	5,360	--	--	52	11.0	--	--	S	Ca. Flowing 1/3 gal/min 9-28-78. Antelope Spring.
19baa(s)	do	--	--	--	--	--	--	3,450	--	--	280	15.8	--	--	S	Flowing 1/4 gal/min 9-28-78. Chalk Spring.
T. 21 S., R. 40 E.																
1dcb(s)	U.S. Bureau of Land Management	--	--	--	--	--	--	2,800	--	--	165	11.0	--	--	S	Flowing 2-3/4 gal/min 9-27-78.

Table 2.--Drillers' logs of selected wells

Materials	Thickness (feet)	Depth (feet)
6S/48E-15adc. Maynard. Altitude 1,760 ft. Drilled by Holloway Drilling Co., 1968. Casing: 6-in. diam to 22 ft; unperforated		
Rock, broken	14	14
Rock, brown, hard	50	64
Rock, creviced	4	68
Rock, black, hard	16	84
Rock, with crevice	2	86
Rock, cracks	21	107
Rock, black, hard	7	114
Rock, crack	1	115
7S/46E-33dcb. Lester LaRue. Altitude 2,790 ft. Drilled by Holloway Drilling Co., 1967. Casing: 6-in. diam to 27 ft; unperforated		
Soil, heavy	3	3
Clay, with boulders	22	25
Clay, brown	52	77
Sand, in clay	1	78
Clay, brown	160	238
Lava rock, green	30	268
Clay, red	5	273
Rock, black, hard	32	305
Clay, yellow	45	350
Rock, black, hard	18	368
Rock, red, porous	11	379
Rock, black, hard	32	411
Clay, red	11	422
Rock, black, hard	33	455
Rock, red	5	460
Rock, black, hard	5	465
Rock, red, crevice	5	470
Rock, red, porous	7	477
7S/48E-4cbc. O. S. Elliot. Altitude 1,760 ft. Drilled by Harold E. Hartling, 1975. Casing: 6-in. diam to 27 ft; unperforated		
Clay and boulders	15	15
Rock, black	7	22
Clay and boulders	9	31
Rock, red	11	42
Clay and rock, gray	4	46
Rock, green	41	87
Rock, red	14	101
Rock, green	3	104
Rock, black, broken	1	105
8S/41E-14abd. Steward Morrissey, Inc. Altitude 2,795 ft. Drilled by B & M Equipment Co., 1963. Casing: 14-in. diam 0-82 ft, 6-in. diam 80-685 ft; perforated 0-685 ft		
Boulders, hard, gray to black	17	17
Clay, brown	8	25
Cinders, medium-red	10	35
Clay, brown	5	40
Clay, blue, with fine sand	43	83
Volcanic rock, hard, black	32	115
Cinders, medium-red	9	124
Volcanic rock, hard, black	31	155
Volcanic rock, broken	13	168
Volcanic rock, hard, black	26	194
Cinders, medium-red	3	197
Volcanic rock, hard, black	68	265
Volcanic rock, broken	22	287
Claystone, blue	29	316
Volcanic rock, broken, black	15	331
Volcanic rock, hard, black	13	344
Claystone, blue	10	354
Volcanic rock, hard, black	213	567
Volcanic rock, hard, red	2	569
Volcanic rock, broken, black	116	685
8S/41E-34cba. U.S. Bureau of Land Management. Altitude 3,700 ft. Drilled by Larry Burd Well Drilling, 1974. Casing: 6-in. diam to 398 ft; perforated 320-398 ft		
Soil and clay	13	13
Conglomerate, brown, soft	14	27
Basalt, red, soft	3	30
Basalt, brown, soft	75	105
Basalt, brown, medium-hard	20	125
Basalt, brown and white, medium-hard	80	205
Basalt, blue, medium-hard	30	235
Basalt, brown, medium-hard	55	290
Basalt, blue-gray, hard	10	300
Basalt, brown, hard	50	350
Basalt, hard, water-bearing	13	363
Basalt, blue-gray, hard	57	420
8S/42E-33abc. U.S. Bureau of Land Management (Gilkison well). Altitude 2,981 ft. Drilled by Denzil Metzer, 1962. Casing: 6-in. diam to 315 ft		
Soil	2	2
Sandstone	6	8
Gravel, cemented	20	28
Basalt, brown	288	316
Clay, blue	9	325
Sand	5	330
8S/46E-8dcb. City of Halfway. Altitude 2,680 ft. Drilled by Rudd W. Davis, 1971. Casing: 12-in. diam to 31 ft, 10-in. diam to 164 ft, 8-in. diam 78-259 ft; perforated 78-259 ft		
Soil, sandy, dark-colored	4	4
Hardpan, brown	8	12
Granite boulders and hardpan	4	16
Clay, light-brown, and gravel	4	20
Boulders and clay	3	23
Clay, brown, and gravel	5	28
Gravel	3	31
Clay, brown, and boulders and gravel	14	45
Clay, brown	3	48
Granite, sand, and gravel	12	60
Hardpan, brown, and cobbles	20	80
Gravel, pea-sized	2	82
Sand, dark-brown, and gravel	22	104
Clay, brown, and cobbles	21	125
Sand, brown, and gravel	32	157
Clay, brown, and gravel	5	162
Clay, brown, and cobbles	24	186
Hardpan, brown, and cobbles	20	206
Clay, brown, and gravel	19	225
Gravel, pea-sized, and coarse sand	26	251
Hardpan, brown, and cobbles	11	262
Clay, brown, and gravel	19	281
8S/46E-15abb. Lewis Laird. Altitude 2,560 ft. Drilled from 140 to 275 ft by Otto Ellsworth, 1963. Casing: 8-in. diam 104-274 ft		
No record		140
Gravel, cemented	5	145
Boulders, cemented	7	152
Clay, brown, with gravel	32	184
Clay, brown	8	192
Clay, sandy, brown	52	244
Gravel, medium	3	247
Clay, brown	13	260
Gravel, water-bearing	14	274
Clay, brown	1	275

Table 2.--Drillers' logs of selected wells--Continued

8S/46E-21abb. Ellingson Lumber Co. Altitude 2,570 ft. Drilled by Holloway Drilling Co., 1965. Casing: 12-in. diam to 134 ft, 10-in. diam 127-307 ft; perforated 30-134 ft, 127-307 ft

Materials	Thickness (feet)	Depth (feet)
Clay and boulders	20	20
Clay and gravel; some water	10	30
Gravel, medium, water-bearing	17	47
Clay, brown	22	69
Gravel and some clay, water-bearing	23	92
Clay, brown	8	100
Gravel, medium, water-bearing	13	113
Clay, with imbedded gravel	13	126
Gravel and sand; some water	6	132
Clay, with thin streaks of gravel	65	197
Clay, brown	50	247
Gravel, medium, water-bearing	7	254
Clay, brown	14	268
Gravel, water-bearing	3	271
Clay, brown	24	295
Gravel, medium, water-bearing	3	298
Clay, brown	3	301
Gravel, medium, water-bearing	4	305
Clay, brown	1	306
Gravel, medium, water-bearing	1	307

9S/41E-2acd. Bureau of Land Management (Hogg well). Altitude 3,480 ft. Drilled by H. H. High, 1940. Casing: Unknown

Materials	Thickness (feet)	Depth (feet)
Sandstone, hard	69	69
Quartz, blue, hard	24	93
Gravel, cemented, hard	47	140
Shale, white	8	148
Shale, yellow	22	170
Shale, blue	16	186
Quartz	24	210
Quartz, very hard	10	220
Sand, soft	9	229

9S/41E-27dcd. U.S. Bureau of Land Management. Altitude 3,910 ft. Drilled by Jess Williams, 1964. Casing: 6-in. diam to 44 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil, brown	2	2
Clay, yellow	42	44
Clay, yellow, hard	174	218
Sand, coarse	--	218

9S/41E-28ada. U.S. Bureau of Land Management. Altitude 3,880 ft. Drilled by A. W. Robinson Water Well Drilling, 1963. Casing: 4-in. diam to 256 ft; perforated 236-256 ft

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Lava rock	21	24
Clay, white	38	62
Lava rock	28	90
Clay, yellow	30	120
Clay, blue-green	40	160
Lava rock	40	200
Clay, black, hard, with fine water-bearing sand at bottom	56	256

9S/42E-16dba. U.S. Bureau of Land Management. Altitude 3,391 ft. Drilled by O. C. Tandy, 1956. Casing: 4-in. diam 4-16 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil	6	6
Sandy formation, hard	14	20
Clay, hard	29	49
Gravel, reddish-brown	9	58
Clay, gray, hard	149	207
Clay, yellow, hard	23	230
Clay, gray, hard	14	244
Clay, chocolate-colored, with gravel	6	250
Clay, blue, with small-sized gravel	31	281

9S/45E-14daa. Vern DuMars. Altitude 2,280 ft. Drilled by Stoffel Bros. Drilling, Inc. Casing: 6-in. diam to 225 ft; perforated 150-160 ft, 180-190 ft, 205-225 ft

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Gravel, cemented	16	19
Clay, gray	3	22
Clay, gray, sticky, and gravel	14	36
Clay, brown, soft	13	49
Clay, brown and blue, sticky, and sand	84	133
Clay, blue, and gravel	3	136
Clay, blue, sticky, and sand	97	233

9S/45E-14dba. Vern DuMars. Altitude 2,250 ft. Drilled by Stoffel Bros. Drilling, Inc. Casing: 4-in. diam to 56 ft; perforated 37-54 ft; unperforsted

Materials	Thickness (feet)	Depth (feet)
Soil	4	4
Gravel, cemented, and boulders	38	42
Sand, water-bearing	3	45
Gravel, cemented	5	50
Sand, water-bearing	1	51
Gravel, cemented	6	57

9S/45E-17cdd. Earl Baker. Altitude 2,580 ft. Drilled by K. Dennis Drilling, 1975. Casing: 6-in. diam to 129 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil	4	4
Clay, brown	26	30
Clay, yellow	72	102
Clay, blue and gray	40	142
Basalt	16	158
Clay, gray	8	166
Clay, brown	29	195
Basalt and gray clay	54	252
Rock, black, water-bearing	8	260
Clay, gray	10	270

10S/41E-24ddc. Ron Ahern. Altitude 3,755 ft. Drilled by Hysell Pump & Drilling, 1971. Casing: 6-in. diam to 42 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil, gravelly	4	4
Clay, brown	13	17
Gravel and sand	20	37
Clay, yellow	26	63
Gravel	3	66
Clay, light-yellow	16	82
Clay, red	8	90
Clay, gray	18	108
Clay, brown	18	126
Sand and gravel	4	130

11S/43E-20ddb. Clarance Pearce. Altitude 2,670 ft. Drilled by Page Bros. Drilling, 1973. Casing: 6-in. diam to 20 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Clay, brown	5	7
Clay, brown, hard	5	12
Clay, dark-brown	16	28
Clay, blue	12	40
Sand, blue, water-bearing	½	40½
Clay, blue	19½	60
Sandstone, blue, broken	2	62
Clay, blue	14	76
Sand, blue, water-bearing	1	77
Clay, blue	53	130

Table 2.--Drillers' logs of selected wells--Continued

11S/43E-28acc. Rod McCullough. Altitude 2,670 ft. Drilled by K. Dennis Drilling, 1977. Casing: 6-in. diam to 265 ft; perforated 50-60 ft, 245-265 ft

Materials	Thickness (feet)	Depth (feet)
Clay, brown, hard	25	25
Clay, yellow	25	50
Clay, blue, soft	60	210
Clay, blue, hard, water-bearing	5	215
Clay, blue, soft	45	260
Clay, blue, hard, water-bearing	5	265
Clay, blue, soft	5	270

11S/43E-36dbd. D. D. D'Ewart. Altitude 2,920 ft. Drilled by Page Bros. Drilling, 1975. Casing: 6-in. diam to 33 ft; perforated 24-33 ft

Materials	Thickness (feet)	Depth (feet)
Soil, rocky	7	7
Clay, brown, sticky	4	11
Soapstone, broken	4	15
Clay, brown, sticky, and gravel	13	28
Sand and gravel, water-bearing	2	30
Clay, brown, gravelly	16	46
Cravel, water-bearing	1	47
Clay, blue	3	50

12S/37E-28bdb. Oregon Department of Transportation, Highway Division. Altitude 3,865 ft. Drilled by Page Bros. Drilling, 1974. Casing: 6-in. diam to 40 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Clay, gravelly	10	10
Cravel, coarse- to medium-sized	25	35
Clay, yellow	35	70
Sandstone, medium-hard, with fractures	44	114
Clay, blue	19	133
Clay, blue, caving	2	135
Clay, blue	5	140

12S/43E-11bda. Oregon Portland Cement Co. Altitude 2,550 ft. Drilled by Page Bros. Drilling, 1977. Casing: 8-in. diam to 57 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Cravel fill	14	14
Soil, brown	3	17
Cravel and sand, water-bearing	35	52
Cravel, large-sized, and cobblestones	4	56

12S/44E-30add. Oregon Department of Transportation, Highway Division. Altitude 2,410 ft. Drilled by Intervalley Drilling Co., 1967. Casing: 8-in. diam to 24 ft; perforated 19-24 ft

Materials	Thickness (feet)	Depth (feet)
Soil, with gravel	1	1
Gravel, large- to small-sized	12	13
Cravel, large-sized, cemented, firm	5½	18½
Cravel, small- to large-sized, water-bearing	3½	22
Cravel, with brown clay, cemented	2	24
Basalt, black, hard	2	26
Basalt, broken, with streaks of rubble and small-sized gravel; heaving	8	34

13S/44E-27ddb. Oregon Portland Cement Co. Altitude 2,240 ft. Drilled by Holloway Drilling Co., 1965. Casing: 8-in. diam to 105 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	6	6
Clay, with imbedded gravel	7	13
Clay, yellow	19	32
Clay, white	9	41
Rock, red; some water	21	62
Rock, white, soft	40	102
Rock, white, broken	3	105
Rock, gray, hard	31	136
Rock, gray, broken, water-bearing	1	137

14S/39E-29baa. John Molthan. Altitude 3,795 ft. Drilled by Holloway Drilling Co., 1951. Casing: 12-in. diam to 152 ft; perforated 25-150 ft

Materials	Thickness (feet)	Depth (feet)
Soil	5	5
Clay, with boulders	20	25
Cravel, water-bearing	10	35
Clay, with imbedded gravel	40	75
Sand and gravel	25	100
Clay, with imbedded gravel	40	140
Cravel and sand	10	150
Shale, blue	700	850
Sand	2	852
Shale, blue	298	1,150
Soapstone	20	1,170
Shale, blue	80	1,250
Soapstone	40	1,290

14S/45E-32daa. Oregon Department of Transportation, Highway Division. Altitude 2,120 ft. Drilled by Holloway Drilling Co., 1970. Casing: 6-in. diam to 63 ft; perforated 42-54 ft

Materials	Thickness (feet)	Depth (feet)
Soil, heavy	3	3
Clay	39	42
Cravel, water-bearing	12	54
Clay, blue	38	92
Sand, black	2	94
Clay, blue	31	125

15S/40E-13bba. Cuss Davis. Altitude 3,910 ft. Drilled by Max Holloway, 1954. Casing: 14-in. diam to 162 ft; perforated 50-75 ft, 95-105 ft, 122-132 ft, 143-155 ft

Materials	Thickness (feet)	Depth (feet)
Soil	15	15
Chalk formation	5	20
Clay	29	49
Sand and gravel	11	60
Not reported	11	71
Clay	23	94
Cravel and sand	10	104
Clay, red, burnt	26	130
Cravel	3	133
Clay, red	7	140
Cravel, bedded in clay	40	180
Clay, hard, burnt	100	280
Cravel	7	287
Cinders, red	13	300

15S/42E-25aba. Mark Velsmeyer. Altitude 2,600 ft. Drilled by H. A. Sevey Drilling, 1960. Casing: 10-in. diam to 34 ft; perforated at 30 ft

Materials	Thickness (feet)	Depth (feet)
Soil	15	15
Cravel	15	30
Clay, yellow	60	90
Clay, sandy, and sand	25	115
Clay, sandy	75	190
Cravel, pea-sized	5	195
Clay, brown	10	205
Shale, blue	30	235
Clay, brown, sandy	15	250
Sandstone, brown	10	260
Clay, brown, sandy	157	417
Cravel, pea-sized	73	490
Clay, brown, sandy	20	510
Clay, sandy, and pea-sized gravel	50	560

15S/45E-4cbb. Clyde Ramsey. Altitude 2,112 ft. Drilled by Holloway Drilling Co., 1969. Casing: 10-in. diam to 40 ft; perforated 22-40 ft

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	5	5
Clay, brown	30	35
Cravel and sand	3	38
Clay, blue	264	302
Sand, blue and gray	1	303

Table 2.--Drillers' logs of selected wells--Continued

15S/47E-29ada. H. B. French. Altitude 2,101 ft. Drilled by Dallas Drilling & Pump Co., Inc., 1977. Casing: 6-in. diam to 29 ft; perforated 21-24 ft

Materials	Thickness (feet)	Depth (feet)
Clay, brown	14	14
Clay and gravel	6	20
Sand and gravel	6	26
Clay, blue	4	30

15S/47E-30dda. Harry Frasier. Altitude 2,099 ft. Drilled by Holloway Drilling Co., 1968. Casing: 16-in. diam to 39 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil, heavy	3	3
Clay, yellow	15	18
Sand, brown, fine	12	30
Sand and gravel	4	34
Gravel, large	5	39
Gravel, medium	1	40

16S/43E-5bdd. Estel Moser. Altitude 2,530 ft. Drilled by Hysell Pump & Drilling, 1965. Casing: 12-in. diam to 40 ft; perforated 18-40 ft

Materials	Thickness (feet)	Depth (feet)
Soil	8	8
Silt, sandy	10	18
Sand, and medium-sized gravel	22	40
Shale, blue, sandy	40	80
Shale, gray, hard	40	120
Shale, blue, sandy	20	140
Sand and pea-sized gravel	2	142
Sand and shale	28	170
Sand and pea-sized gravel	5	175
Sand and shale	45	220
Sand, black	3	223
Shale, sandy	27	250
Sand, black	5	255
Sand and pea-sized gravel	5	260
Shale, blue	2	262

16S/45E-7bdc1. U.S. Bureau of Land Management. Altitude 2,720 ft. Drilled by Page Bros. Drilling, 1976. Casing: 6-in. diam to 118 ft, 5-in. diam 90-111 ft; perforated 97-118 ft

Materials	Thickness (feet)	Depth (feet)
Clay, yellow, sticky	85	85
Clay, yellow, sandy, fine	7	92
Clay, yellow, sandy, medium-fine	15	107
Clay, blue, fine	3	110
Sand, light-blue, medium- to fine-grained	15	125

16S/46E-26dac. Hyline Ranch. Altitude 2,757 ft. Drilled by Holloway Drilling Co., 1971. Casing: 8-in. diam to 21 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil, heavy	4	4
Clay, with gravel	4	8
Clay, brown	136	144
Clay, blue	120	264
Rock and sand	1	265
Clay, blue	335	600
Rock	5	605
Clay, blue	1	606

16S/47E-17abc. Robert Lucas. Altitude 2,370 ft. Drilled by Holloway Drilling Co., 1977. Casing: 6-in. diam to 100 ft; perforated 80-100 ft

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	3	3
Clay, yellow	9	12
Gravel, cemented	23	35
Clay, crumbly	45	80
Clay, sandy	15	95
Clay, blue	185	280
Sand	1	281
Clay, blue	119	400
Clay, crumbly	10	410

16S/47E-35dab. Charles Degitz. Altitude 2,170 ft. Drilled by Holloway Drilling Co., 1972. Casing: 6-in. diam to 59 ft; perforated 54-59 ft

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	3	3
Clay	23	26
Sand and gravel	32	58
Clay, blue	5	63

17S/47E-10acc. George Duerr. Altitude 2,132 ft. Drilled by Holloway Drilling Co., 1977. Casing: 12-in. diam to 30 ft; perforated 20-30 ft

Materials	Thickness (feet)	Depth (feet)
Soil	3	3
Clay	10	13
Clay, sandy	7	20
Sand and gravel	5	25
Gravel	3	28
Clay, blue	36	64
Sand, black	1	65

18S/41E-8dca. R. C. Stewart. Altitude 3,030 ft. Drilled by H. A. Sevey Drilling, 1960. Casing: 12-in. diam to 54 ft; perforated 25-52 ft

Materials	Thickness (feet)	Depth (feet)
Soil	5	5
Gravel and soil	15	20
Gravel, coarse	32	52
Chalk	98	150
Sandstone and chalkstone, layered	100	250
Clay, brown, sandy, and black sand	30	280

18S/45E-21bbc. K. T. Loomis. Altitude 2,235 ft. Drilled by Peerless Pump Co., 1960. Casing: 12-in. diam to 40 ft; perforated 10-40 ft

Materials	Thickness (feet)	Depth (feet)
Hardpan	9	9
Clay, yellow	8	17
Gravel, sandy	10	27
Shale, sandy	38	65
Shale, black	100	165

18S/46E-9bdd. R. W. Metlin. Altitude 2,290 ft. Drilled by Holloway Drilling Co., 1977. Casing: 6-in. diam to 40 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	3	3
Sand, hard	42	45
Clay, brown	10	55
Clay, blue	39	94
Sand, blue	1	95
Clay, blue	195	290
Sand streak	2	292
Clay, gray	8	300
Clay, white	3	303

18S/47E-2cdd. City of Ontario. Altitude 2,138 ft. Drilled by Witt & Sons, 1969. Casing: 6-in. diam to 26 ft, 4-in. diam 40-50 ft; unperforated

Materials	Thickness (feet)	Depth (feet)
Silt, blue, fine	8	8
Sand, fine, and gravel	12	20
Silt, fine-grained	3	23
Gravel, ½- to 1½-in. diameter	11	34
Sand, medium-grained	6	40
Sand, blue, medium-grained	8	48
Clay, blue, sandy	3	51

Table 2.--Drillers' logs of selected wells--Continued

18S/47E-9dbd. Treasure Valley College. Altitude 2,150 ft. Drilled by Holloway Drilling Co., 1968. Casing: 16-in. diam to 33 ft; perforated 21-33 ft

Materials	Thickness (feet)	Depth (feet)
Soil, sandy	3	3
Clay, yellow	7	10
Clay, sandy	11	21
Gravel, sandy	10	31
Clay, blue	29	60
Sand, black	1	61
Clay, blue	19	80
Sand, black	2	82
Clay, blue	18	100

18S/47E-11baa. City of Ontario. Altitude 2,138 ft. Drilled by A. E. Hosack & Son, 1961. Casing: 16-in. diam to 29 ft; perforated 29-30 ft

Materials	Thickness (feet)	Depth (feet)
Soil and silt	3	3
Gravel, cemented	6	9
Gravel, small, in clay	4	13
Gravel, medium	7	20
Gravel, coarse	5	25
Gravel, medium, and coarse sand	16	41
Clay, blue, coarse	9	50

19S/42E-35bbb. J. E. O'Toole. Altitude 2,470 ft. Drilled by Harry A. Sevey, 1956. Casing: 12-in. diam to 18 ft; perforated 12-18 ft

Materials	Thickness (feet)	Depth (feet)
Soil	8	8
Sand and gravel	10	18
Shale, blue	7	25
Rock	3	28
Clay, brown	4	32
Rock and clay	8	40
Gravel	5	45
Rock and clay	55	100

19S/43E-3bca. F. G. Vaughn. Altitude 2,355 ft. Drilled by H. A. Sevey Drilling, 1961. Casing: 16-in. diam to 38 ft; perforated 30-37 ft

Materials	Thickness (feet)	Depth (feet)
Soil	18	18
Sandstone and gravel	11	29
Sandstone	16	45
Shale, sandy	105	150
Shale, blue, sticky	85	235
Shale, sandy	32	267
Shale	13	280
Shale, hard	5	285
Shale, sandy	5	290
Sand, black	10	300
Shale, blue	26	326
Rock	2	328
Shale, blue	242	570
Rock	98	668
Shale, hard	2	670
Rock, hard	20	690

19S/43E-22dda. U.S. Bureau of Land Management. Altitude 2,968 ft. Drilled by Denzil N. Metzer, 1965. Casing: 6-in. diam to 718 ft; perforated 678-718 ft

Materials	Thickness (feet)	Depth (feet)
Sandstone	442	442
Clay, blue	21	463
Sandstone	17	480
Clay, blue	222	702
Sand and gravel	8	710
Gravel	8	718
Clay, blue	--	--

19S/45E-5bbb. U.S. Bureau of Land Management. Altitude 2,262 ft. Drilled by Page Bros. Drilling, 1975. Casing: 6-in. diam to 27 ft; perforated 21-27 ft

Materials	Thickness (feet)	Depth (feet)
Clay, brown, sticky	19	19
Gravel, cemented	2	21
Gravel and sand, water-bearing	4	25
Conglomerate, hard	2	27
Shale, blue	55	82
Shale, blue-gray	10	92

19S/45E-9dbb. U.S. Bureau of Land Management. Altitude 2,820 ft. Drilled by C. B. Eaton & Sons, 1964. Casing: 6-in. diam to 696 ft; perforated 596-696 ft

Materials	Thickness (feet)	Depth (feet)
Gravel, cemented	42	42
Sandstone	57	99
Gravel, cemented	42	141
Shale, gray	96	237
Sandstone	72	309
Shale, green	161	470
Sandstone	35	505
Gravel, cemented	17	522
Sandstone	75	597
Clay, with sand strips	99	696

19S/45E-28acb. U.S. Bureau of Land Management. Altitude 2,845 ft. Drilled by Glenn Hysell, 1969. Casing: 6-in. diam to 620 ft; perforated 540-620 ft

Materials	Thickness (feet)	Depth (feet)
Sandstone, soft	25	25
Sand	20	45
Sandstone, hard	2	47
Sandstone, soft	98	145
Sandstone, hard, coarse	20	165
Sand, brown	20	185
Shale, brown, sandy	115	300
Shale, blue, sandy	93	393
Sand and pea-sized gravel	7	400
Shale, blue	183	583
Sand and pea-sized gravel	3	586
Shale, blue, sandy	32	618
Sand, black, coarse	4	622

19S/46E-4dba. Roger Findley. Altitude 2,622 ft. Drilled by Page Bros. Drilling, 1977. Casing: 16-in. diam to 187 ft, 12-in. diam to 210 ft

Materials	Thickness (feet)	Depth (feet)
Soil	2	2
Hardpan	6	8
Gravel, cemented	5	13
Gravel, loose	3	16
Clay, yellow, hard	44	60
Sandstone	2	62
Clay, yellow	26	88
Sandstone	5	93
Sand, brown	6	99
Clay, yellow, hard	61	160
Sandstone	3	163
Clay, yellow, soft	17	180
Claystone, yellow, hard	6	186
Sand, brown	14	200
Sandstone, hard	3	203
Sand, medium	4	207
Clay, yellow, sandy, fine	133	340
Clay, sandy, coarse	3	343
Sandstone	2	345
Sand, medium, water-bearing	2	347
Clay, sandy, soft	98	445
Sandstone, fractured	6	451
Sand, medium to fine	19	470

Materials	Thickness (feet)	Depth (feet)
19S/46E-21bad. Albertson's Land & Cattle Co. Altitude 2,625 ft. Drilled by J. Miller Smith, 1975. Casing: 12-in. diam to 572 ft; perforated 20-572 ft		
Soil	3	3
Clay, yellow, and sand, gravel, and cobbles	19	22
Sandstone, brown, hard	35	57
Sand, coarse, and fine gravel	20	77
Sandstone, brown	205	282
Sand and gravel	10	292
Clay, brown	90	382
Sand, blue, hard	10	392
Sandstone, brown	12	404
Rock, hard	4	408
Sand, black, and gravel	7	415
Shale, dark-gray	2	417
Sandstone, brown	10	427
Rock, gray, hard	5	432
Shale, blue, fractured	20	452
Clay, dark-blue	10	462
Sandstone, dark-gray	10	472
Sandstone mixed with gray clay	10	482
Sandstone, light-gray	10	492
Clay, gray, sandy	3	495
Gravel, small-sized, and sand	2	497
Clay, gray, sandy	5	502
Shale, gray, hard	23	525
Sand and gray clay	1	526
Sandstone, gray, and clay	6	532
Sandstone, gray	13	545
Rock, gray, hard	3	548
Sandstone, gray	4	552
Shale, blue, fractured	2	554
Sand, black	8	562
Sandstone, black	6	568
Shale, blue, fractured	4	572

Materials	Thickness (feet)	Depth (feet)
19S/47E-8acc. Clarence Hart. Altitude 2,181 ft. Drilled by Holloway Drilling Co., 1967. Casing: 16-in. diam to 46 ft, 12-in. diam 70-110 ft; perforated 27-47 ft, 70-110 ft		
Soil, sandy	4	4
Sand	17	21
Sand and gravel	24	45
Clay, blue	45	90
Sand, black	10	100
Clay, blue	40	140
Sand, black	5	145
19S/47E-17ddd. Albertson's Land & Cattle Co. Altitude 2,165 ft. Drilled by Holloway Drilling Co., 1970. Casing: 24-in. diam to 43 ft, 12-in. diam to 82 ft; perforated 33-82 ft		
Soil, heavy	3	3
Clay, yellow	11	14
Gravel, cemented	8	22
Sand and gravel	21	43
Clay, blue	35	78
Sand, blue	16	94
Clay, blue	76	170
Sand, black	5	175

Table 3.—Source and significance of chemical and physical characteristics of water

Constituent	Potential source(a)	Significance or definition
Silica (SiO_2)	Silicate minerals in rocks.	Forms hard scale in high-pressure boilers.
Iron (Fe)	Iron-bearing minerals, well casings, and pipes.	In concentrations greater than 0.3 mg/L, may stain laundry and porcelain plumbing fixtures (National Academy of Sciences, 1974). Larger concentrations may impart objectionable taste to water.
Manganese (Mn)	Manganese-bearing minerals, decomposition of plant tissue.	In concentrations greater than 0.05 mg/L may cause brown to black stain in laundry and porcelain plumbing fixtures (National Academy of Sciences, 1974). Generally has same objectionable features as iron.
Calcium (Ca)	Rocks, soils, and "hardpan" deposits rich in calcium carbonate minerals and from fertilizers.	A constituent of scale deposits in water pipes, boilers, and cookware. Principal cause of water hardness.
Magnesium (Mg)	Ferromagnesium minerals in rocks.	A constituent of scale deposits in water pipes, boilers, and cookware. Second principal cause of water hardness.
Sodium (Na)	Sodium-bearing minerals in rocks; industrial wastes	Large concentrations in combination with chloride give water salty taste. Large concentrations in irrigation water may reduce soil permeability.
Potassium (K)	Potassium-bearing minerals in rocks; present in plant tissue, sewage, industrial wastes, and fertilizers.	Essential plant nutrient.
Bicarbonate (HCO_3) and carbonate (CO_3)	Carbon dioxide in air and soil atmosphere, "hardpan" deposits, or cementing material in sediments; also decomposition of organic matter in soil.	In combination with calcium and magnesium, cause carbonate hardness. Carbonates of calcium and magnesium form hard scale in steam boilers and hot-water facilities and release corrosive carbon dioxide gas.
Sulfate (SO_4)	Sulfide minerals in rocks, gypsum, precipitation, fertilizers, and sewage.	Sulfates of calcium and magnesium form hard scale. In concentrations greater than about 250 mg/L may have unpleasant taste and be cathartic to some individuals (National Academy of Sciences, 1974).
Chloride (Cl)	Soils and rocks, evaporite minerals, precipitation, animal wastes, and sewage.	Makes water corrosive; more than 250 mg/L may impart salty taste to water (National Academy of Sciences, 1974).
Fluoride (F)	Fluoride-bearing minerals which occur in trace amounts in most rocks.	Optimum concentrations tend to reduce decay of children's teeth; larger concentrations cause mottling of enamel of teeth. Concentration of fluoride in drinking water should not exceed 2 mg/L (U.S. Environmental Protection Agency, 1975).
Nitrate (NO_3) as N	Bacterial action in soil and plants; concentrated in plant and animal wastes, sewage, and fertilizers.	Essential plant nutrient. In surface water excessive nitrate and phosphates in combination cause algal blooms which may result in organic enrichment of water and depletion of dissolved oxygen. Consumption of water with more than about 10 mg/L of nitrate as N may cause methemoglobanemia in infants (U.S. Environmental Protection Agency, 1975). In excess of average concentrations may indicate pollution by organic wastes.
Phosphorus (P or phosphate (PO_4)	Phosphorus-bearing minerals present in most rocks in trace amounts. Component of sewage, animal wastes, fertilizers, and some detergents.	Essential plant nutrient. See nitrate.
Boron (B)	Boron-bearing minerals, volcanic gases, thermal springs, and sewage.	Essential in trace amounts to plant nutrition. In concentrations greater than about 2 mg/L, may be toxic even to tolerant crops (National Academy of Sciences, 1974).
Arsenic (As)	Dissolved from arsenic-bearing minerals. Ingredient of many herbicides and insecticides.	Prolonged consumption of water containing more than about 0.05 mg/L of arsenic may lead to chronic poisoning (U.S. Environmental Protection Agency, 1975).
Dissolved solids (residue on evaporation or calculated)		Measure of the concentration of dissolved solids in water.
Specific conductance		Indicator of the ability of a solute to conduct an electrical current. Gives indication of the concentration of dissolved solids in water.
Hardness as ($CaCO_3$)	Mainly dissolved calcium and magnesium in water.	Property of water related to the formation of an insoluble curd with soap and the formation of scale in pipes, boilers, and cooking utensils.
pH (hydrogen ion activity)	Hydrogen ions in solution.	Hydrogen ion activity expressed in negative logarithmic units. A measure of the dissociation of water molecules. A neutral solution has a pH of 7.0.
Temperature	Determined by local environment.	Important physical characteristic that affects taste, efficiency of waste-treatment processes, cooling, suitability of habitat for aquatic life, and suitability for irrigation.
SAR (sodium-adsorption-ratio)	Calculated from the following equation: $SAR = \frac{(Na^{+})}{\sqrt{\frac{(Ca^{+2}) + (Mg^{+2})}{2}}}$ where: Na^{+2}, Ca^{+2}, Mg^{+2} are in milliequivalents per liter.	Equation predicts the degree to which irrigation water tends to enter into cation-exchange reactions in soil. High SAR values imply a hazard of sodium replacing adsorbed calcium and magnesium; this replacement is damaging to soil structure.

Table 4.--Chemical analyses of ground-water samples

[Analyses by the U.S. Geological Survey unless otherwise noted. Tr, trace]

Location no.	Depth of well (feet)	Date of collection	Milligrams per liter																			Sodium-adsorption-ratio (SAR)	Specific conductance (micromhos/cm at 25°C)	pH	Temperature	
			Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrite (NO_2) + nitrate (NO_3) as N	Phosphate, ortho as P	Boron (B)	Arsenic (As)	Dissolved solids, calculated from determined constituents	Hardness (Ca, Mg)	Noncarbonate hardness				°C	°F
1/8S/39E-22bdd	12	6-47	--	--	--	42	12	19	2.4	232	0	2.4	0	--	--	--	Tr	--	--	--	--	0.7	320	6.8	--	--
1/9S/39E-2ccc	321	do	--	--	--	54	15	21	1.6	250	0	13	0	--	--	--	Tr	--	--	--	--	.8	350	7.6	--	-
9S/40E-18dcb	575	8-15-64	52	0.16	0	19	13	60	5.4	258	0	19	5	0.4	--	--	0.3	--	302	102	0	2.6	443	7.7	15.6	60
12S/38E-27aab	81	9-25-63	--	--	--	109	109	38	7.8	626	0	91	49	--	2/205	--	.00	--	--	720	207	.6	1,400	7.6	12.0	54
12S/43E-11bda	56	11-14-78	42	.07	.80	76	17	57	6.2	246	0	82	6.9	.3	.08	--	.13	0.003	411	260	--	1.5	640	--	10.0	50
15S/40E-2ccb	310	5-24-55	55	--	--	26	10	19	3.3	143	8	--	8	--	2/1.4	--	--	--	--	106	0	.8	293	8.7	12.0	54
15S/40E-2daa	421	7-21-55	46	--	--	--	--	25	--	153	9	--	9	--	--	--	--	--	--	108	0	--	318	8.6	--	--
15S/40E-10dbc	1,000	5-24-55	87	--	--	13	8.9	54	12	195	18	--	7	--	2/.3	--	--	--	--	69	0	2.8	382	8.8	24.5	76
15S/40E-11cdb	200	5-26-55	54	--	--	37	14	42	5	284	0	--	7	--	2/.6	--	--	--	--	150	0	1.5	465	8.2	14.0	57
15S/40E-13bba	300	7-22-55	49	--	--	--	19	--	--	175	11	--	6	--	--	--	--	--	--	138	0	--	328	8.7	--	--
15S/40E-14dcb	248	5-26-55	48	--	--	29	9.3	21	3.6	181	0	--	4	--	2/1.9	--	--	--	--	111	0	.9	304	8.2	15.0	59.5
15S/41E-8cbc	360	5-25-55	52	--	--	25	5.5	21	4.1	139	6	--	4	--	2/2.1	--	--	--	--	85	0	1.0	264	8.6	19.5	67
16S/45E-7bdc1	125	9-30-78	29	--	--	100	32	59	19	107	0	460	11	1.0	.02	0.01	.08	.003	3/806	380	--	1.3	1,080	6.7	--	--
16S/45E-7bdc2	100	do	43	1.5	2.9	100	31	60	17	101	0	400	11	.7	.17	--	.09	.040	718	380	290	1.3	870	6.5	15.2	59
16S/45E-10dcc	100	8-31-78	76	--	--	50	11	77	24	256	0	130	5.0	.3	.86	.10	.12	.160	3/498	170	--	2.6	650	7.5	17.0	62.5
16S/47E-16bdd	75	10-29-78	54	--	--	63	24	120	4.7	439	0	110	25	.4	--	.08	.13	.013	3/618	260	0	3.3	890	6.8	16.7	62.0
17S/45E-2ccb	650	9-27-78	84	.76	.09	18	2.7	390	8.8	1,085	0	8.5	41	.4	.06	--	.87	.110	1,098	56	--	23	1,730	7.5	24.8	76.5
18S/37E-34dac(s)	--	9-26-78	84	.07	0	16	6.3	32	9.8	134	0	17	7.8	.3	.89	--	.05	.003	241	66	--	1.7	320	--	15.6	60.0
18S/43E-9bbc(s)	--	9-28-78	130	.05	.06	18	.4	210	16	210	0	140	120	9.8	.04	--	4.4	.031	395	47	--	13	730	7.2	62.0	143.5
18S/46E-9bdd	303	10-27-78	59	--	--	48	11	17	6.8	171	0	37	13	.3	--	.05	.10	.011	276	170	25	.6	390	6.1	16.8	62.0
4/18S/47E-11baa	50	7- 1-68	13	<.01	.11	51	25	53	5.3	254	0	90	18	.8	1.18	5/.19	--	<.005	6/419	230	--	1.9	550	7.7	--	--
4/18S/47E-11bda1	80	do	30	<.01	.03	44	21	54	5.5	222	0	84	27	.8	.57	5/.30	--	.010	6/384	196	--	1.8	500	7.8	--	--
4/18S/47E-11bda2	78	do	16	.01	.23	54	24	68	5.8	296	0	91	29	1.0	2.38	--	--	<.005	6/450	233	--	1.5	610	7.5	--	--

See footnotes at end of table.

Table 4.--Chemical analyses of ground-water samples--Continued

Location no.	Depth of well (feet)	Date of collection	Milligrams per liter: Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrite (NO_2) + nitrate (NO_3) as N	Phosphate, ortho as P	Boron (B)	Arsenic (As)	Dissolved solids, calculated from determined constituents	Hardness (Ca, Mg)	Noncarbonate hardness	Sodium-adsorption-ratio (SAR)	Specific conductance (micromhos/cm at 25°C)	pH	Temperature °C	Temperature °F
19S/39E-19dab(s)	--	9-28-78	46	0.13	0	10	3.1	8.3	3.1	57	0	4.6	2.4	0.1	0.35	--	0.03	0.001	107	38	--	0.6	140	--	9.6	49.0
19S/43E-22dda	718	8-30-78	86	--	--	3.4	0	170	8.6	--	--	94	10	3.0	.59	0.06	.57	.180	514	9	--	25	810	8.7	29.5	85.1
19S/45E-5bbb	92	9-28-78	52	.28	.12	53	14	470	11	427	0	680	89	2.0	.96	--	1.10	.094	1,587	190	--	15	2,130	7.8	14.8	58.5
19S/45E-28acb	620	9-27-78	89	.08	.04	21	1.5	52	13	158	0	48	4.0	.8	.11	--	.08	.110	309	59	--	3.0	374	7.7	28.6	83.5
19S/46E-4dba	470	10-24-78	64	--	--	100	31	63	17	305	0	240	35	.4	--	.04	.13	.045	701	380	130	1.4	980	6.9	24.0	75.0
19S/47E-17ddd	175	10-25-78	60	--	--	58	16	82	17	219	0	66	57	.6	--	.08	.14	.008	465	210	31	2.5	850	7.0	14.7	58.5
20S/39E-2cbc(s)	--	9-28-78	27	.11	0	5.0	1.4	2.7	1.4	18	0	2.3	.7	.1	.56	--	.02	.001	50	18	--	.3	52	--	11.0	52.0

1/ Analysis by the U.S. Bureau of Reclamation.

2/ Dissolved nitrate (NO_3) as NO_3.

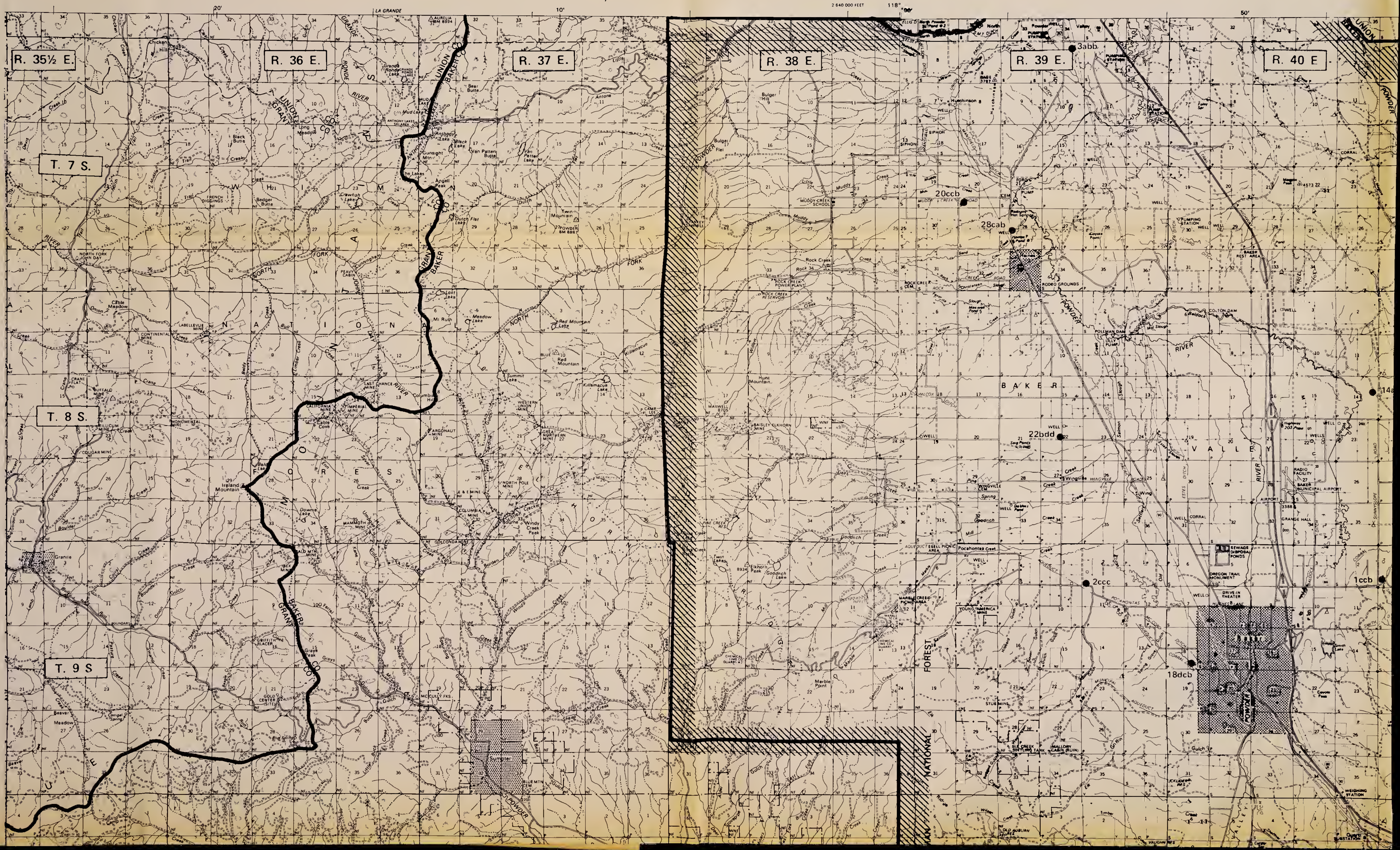
3/ Residue at 180°C.

4/ Analysis by Oregon Department of Human Resources, Health Division.

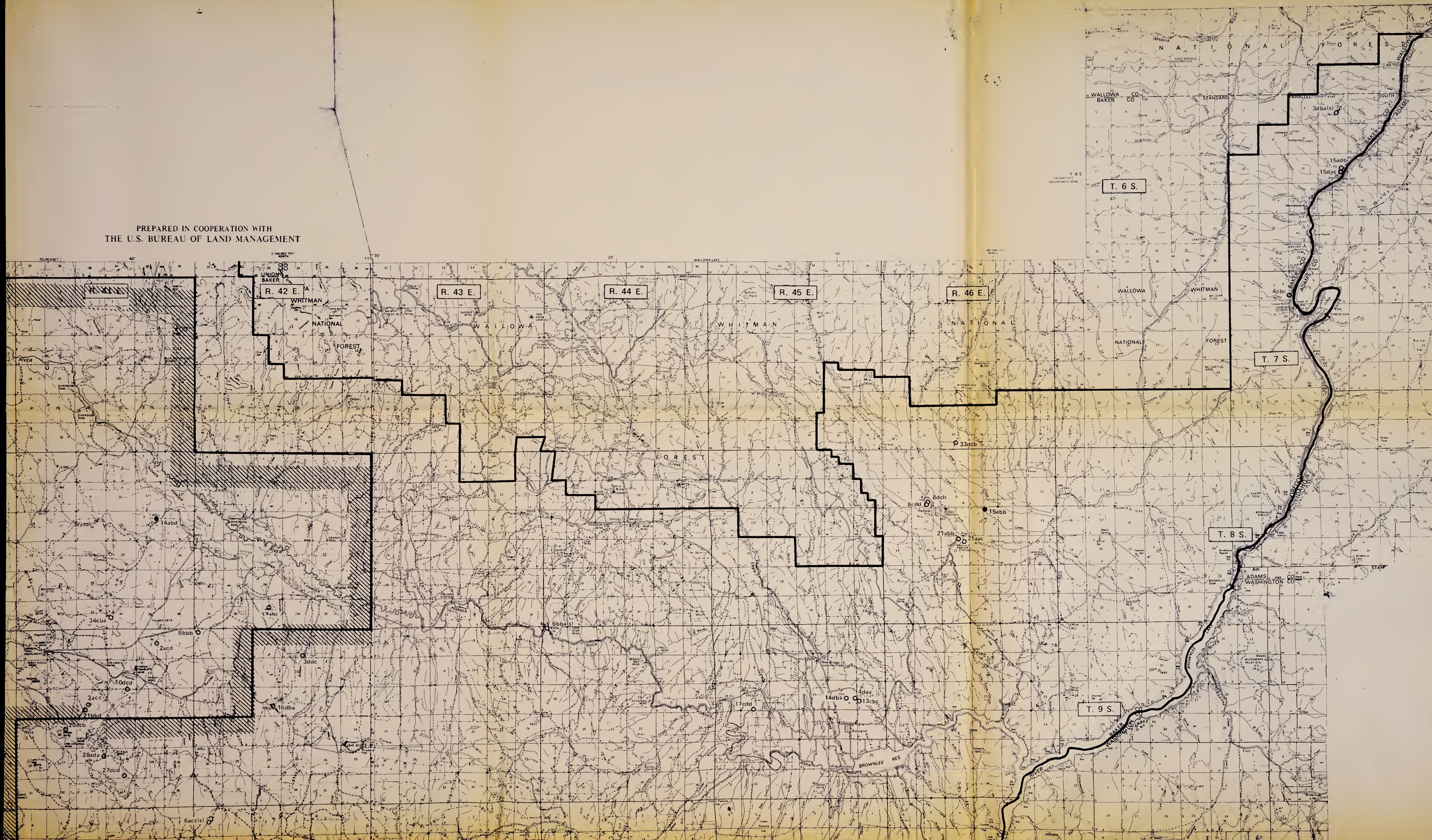
5/ Total phosphate (PO_4).

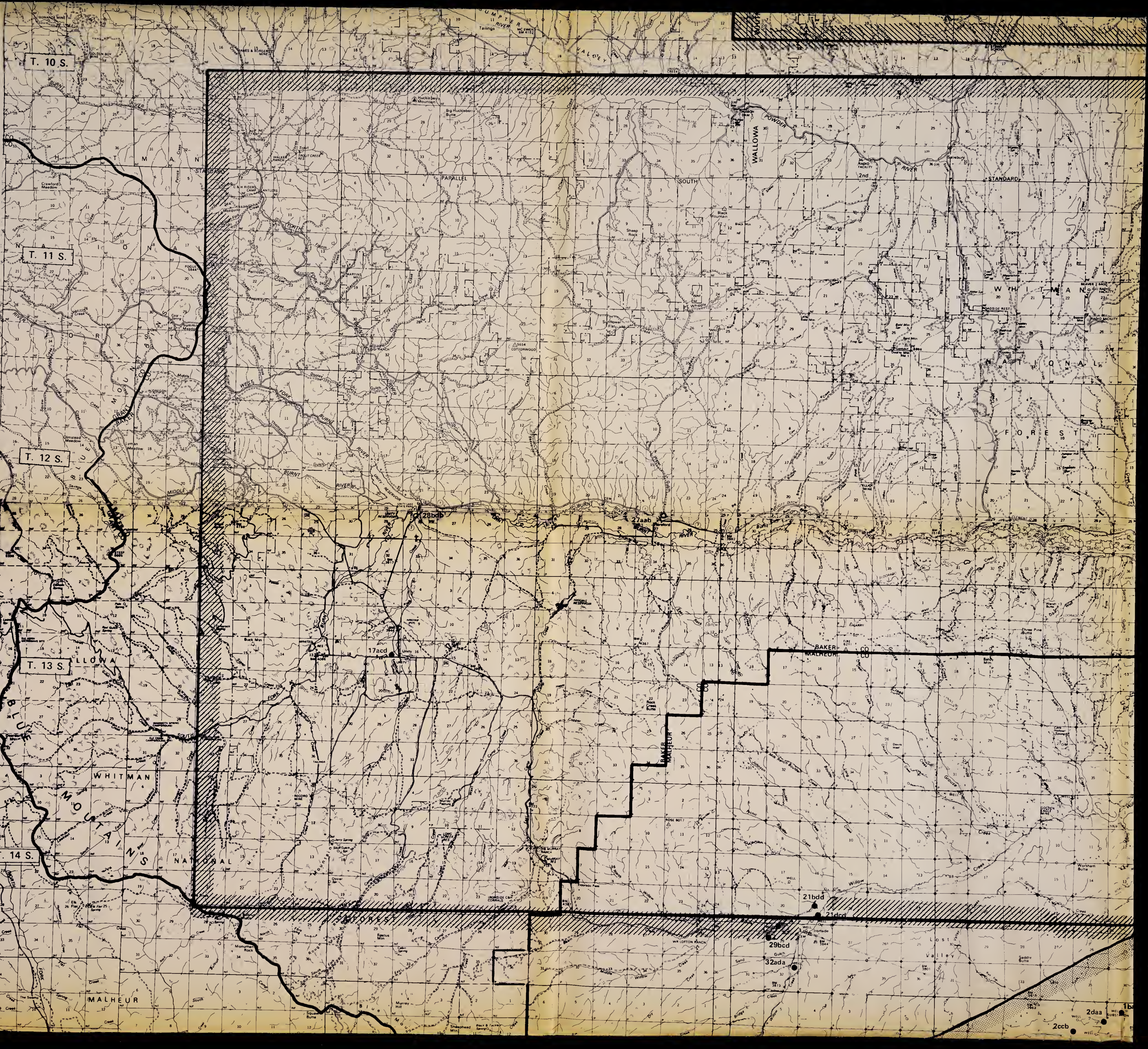
6/ Total solids.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

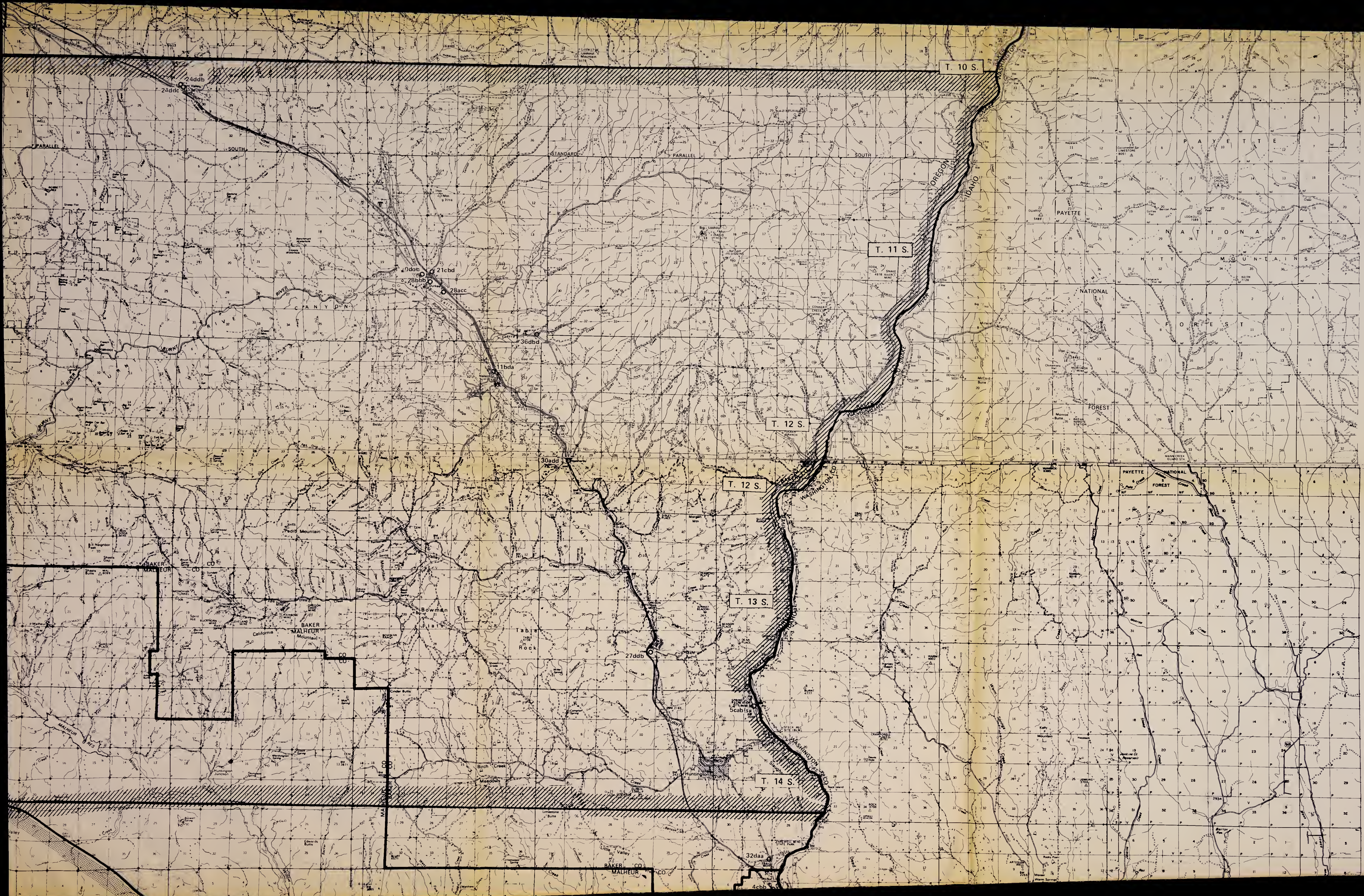


PREPARED IN COOPERATION WITH
THE U.S. BUREAU OF LAND MANAGEMENT

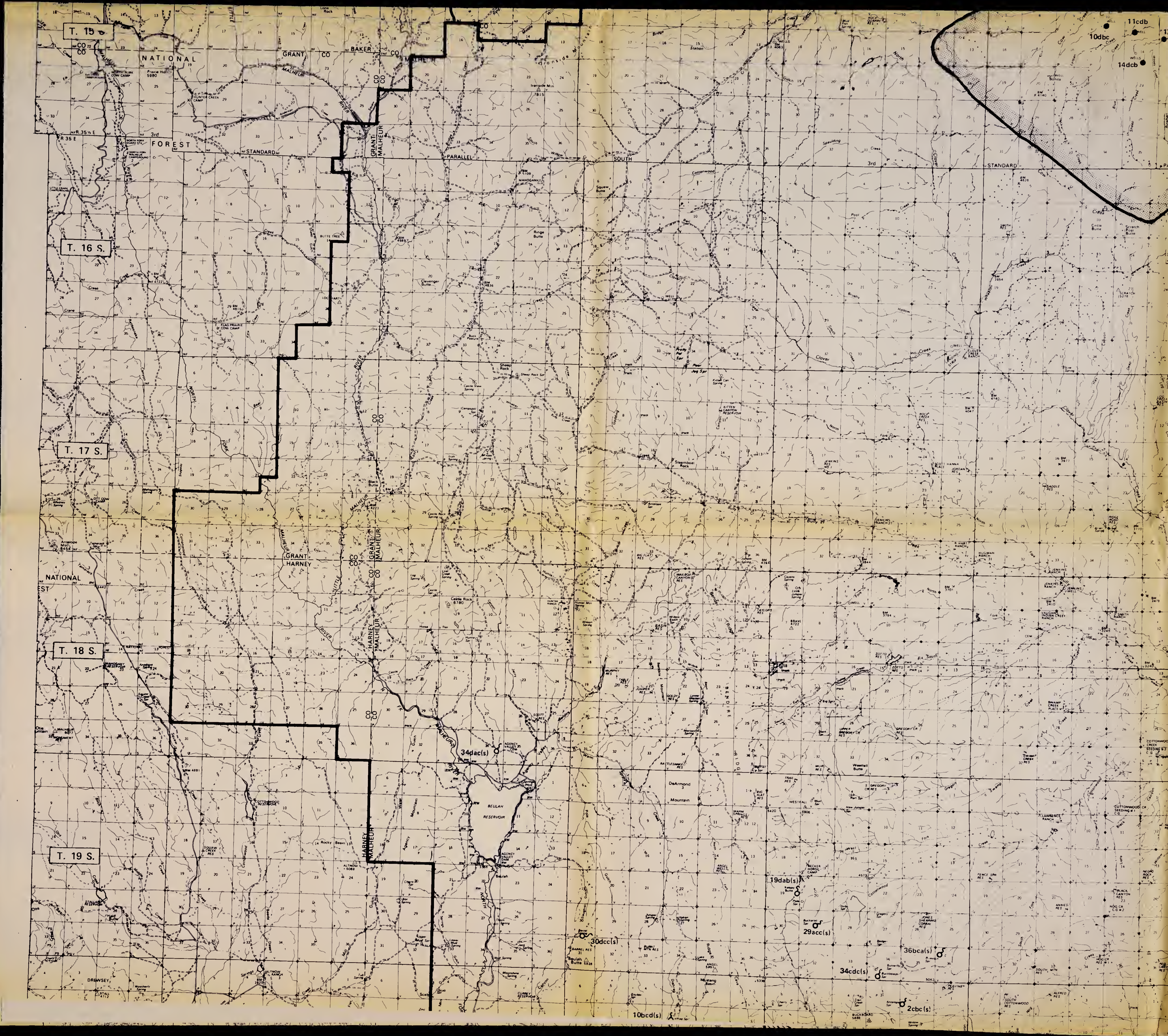




T. 10 S.
T. 11 S.
T. 12 S.
T. 13 S.
T. 14 S.
SUMPTER
VALLEY
WALLOWA
POWDER
RIVER
STANDARD
PARALLEL
SOUTH
2nd
STANDARD
WHITMAN
NATIONAL
FOREST
BURNT
RIVER
MIDDLE
28bdb
27aab
17acd
BAKER
MALHEUR
CO
CO
BAKER
MALHEUR
BLUE
MOUTAINS
WHITMAN
NATIONAL
FOREST
LLOWA
21bdd
21dcd
29bcd
32ada
Lost
Valley
MALHEUR
2daa
2ccb

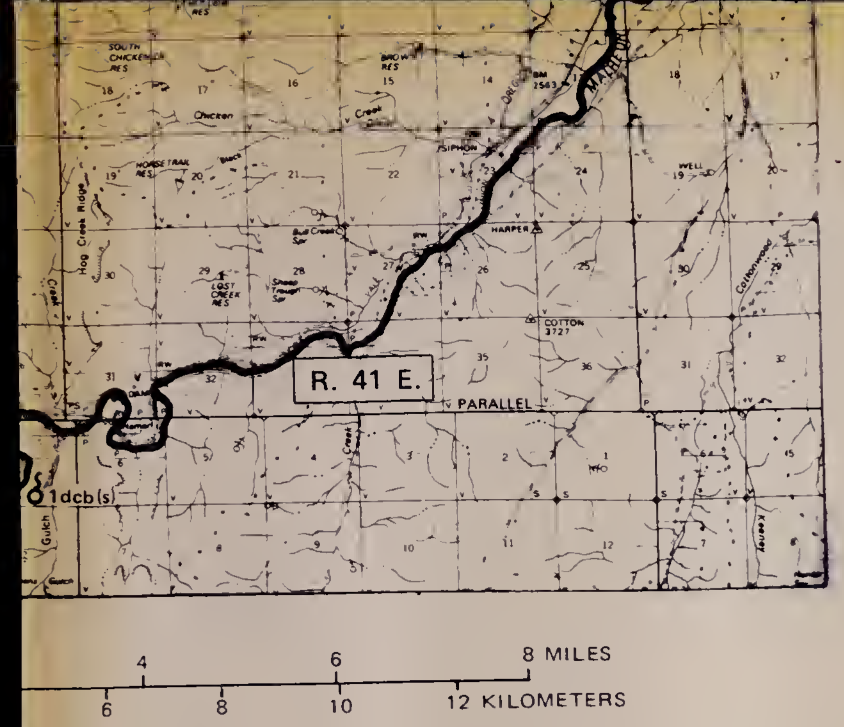


T. 10 S.
T. 11 S.
T. 12 S.
T. 12 S.
T. 13 S.
T. 14 S.
PARALLEL
SOUTH
2nd
STANDARD
PARALLEL
SOUTH
OREGON
IDAHO
WASHINGTON
WASHINGTON CO
WASHINGTON CO
PAYETTE
PAYETTE
NATIONAL
HITT
MOUNTAINS
NATIONAL
FOREST
FOREST
PAYETTE
NATIONAL
FOREST
24ddb
24ddc
21cbd
28bbb
28acc
36dbd
11bda
30add
27ddb
5cab
32daa
4cbb
CANYON
RIVER
BURNT
RIVER
Pedro Mountain
BAKER
MALHEUR
CO
CO
Bowman
Table
Rock
California
BAKER
MALHEUR
Mountain
CO
MALHEUR
RES
Birch Creek
Meadows
BAKER CO
MALHEUR CO


T. 16 S.
T. 17 S.
T. 18 S.
T. 19 S.
NATIONAL
FOREST
GRANT CO
BAKER CO
MALHEUR
HARNEY
3rd
STANDARD
PARALLEL
SOUTH
RIVER
BEULAH
RESERVOIR
DeArmond
Mountain
11cdb
10dbc
14dcb
34dac(s)
19dab(s)
29acc(s)
30dcc(s)
36bca(s)
34cdc(s)
2cbc(s)
10bcd(s)


R. 42 E.
R. 43 E.
R. 44 E.
R. 45 E.
R. 46 E.
R. 47 E.
R. 48 E.
T. 15 S.
T. 16 S.
T. 17 S.
T. 18 S.
T. 19 S.
44° 00'
OREGON
IDAHO
WASHINGTON CO.
MALHEUR CO.
SNAKE RIVER
WEISER RIVER
MALHEUR
SOUTH
3rd
STANDARD
PARALLEL
Tub Mountain
Alkali Flats
BULLY CREEK
EXPLANATION
8cbc
25aba
29bba(s)
25cac(s)
33daa(s)
36cdd(s)
5bdd
7bdc1,2
10dcc
16dcc
29ada
30dda
17abc
16bdd
5aba(s)
31ddd(s)
26dac
35dab
35dbd1,2
11dba
2ccb
7add
10acc
25ada
4cbb
8dca
9bbc(s)
6bad
18aca
9bdd
2cdd
11baa
11bda1,2
9dbd
17bbb
16bbb
21bbc
19cca
19dbb
19dbd
23dcc
3bca
3dba
2cbc
10ada
5bbb
4aba
9dbb
11bcc
8acc
18dba
22dda
21bad
18ddc
17ddd
28acb
35bbb
28ccb

WELL AND SPRING LOCATIONS



22dda ○ Well – Location number shown. (See text for explanation)

10ada ● Observation well.

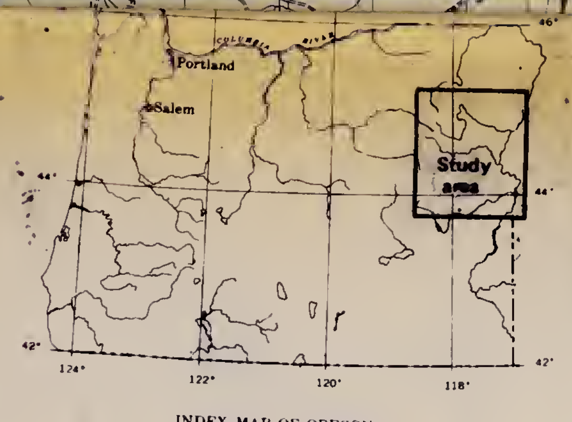
1dcb(s) Spring – Location number shown. (See text for explanation)

Area covered by Ground-Water Report No. 6, (Ducret and Anderson, 1965) and by Hydrologic Investigations-Atlas 242 (Lystrom, Nees, and Hampton, 1967)

Area covered by Water-Supply Paper 1839-I. (Price, 1967)

Area covered by Water-Supply Paper 1619-M. (Brown and Newcomb, 1962)

Boundary of project area.



INDEX MAP OF OREGON

Base prepared by the
U.S. Bureau of Land Management

IN THE BAKER COUNTY-NORTHERN MALHEUR COUNTY AREA, OREGON

Table 4.--Chemical analyses of ground-water samples--Continued

Location no.	Depth of well (feet)	Date of collection	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrite (NO_2) + nitrate (NO_3) as N	Phosphate, ortho as P	Boron (B)	Arsenic (As)	Dissolved solids, calculated from determined constituents	Hardness (Ca, Mg)	Noncarbonate hardness	Sodium-adsorption-ratio (SAR)	Specific conductance (micromhos/cm at 25°C)	pH	Temperature °C	Temperature °F
			Milligrams per liter																							
19S/39E-19dab(s)	--	9-28-78	46	0.13	0	10	3.1	8.3	3.1	57	0	4.6	2.4	0.1	0.35	--	0.03	0.001	107	38	--	0.6	140	--	9.6	49.0
19S/43E-22dda	718	8-30-78	86	--	--	3.4	0	170	8.6	--	--	94	10	3.0	.59	0.06	.57	.180	514	9	--	25	810	8.7	29.5	85.1
19S/45E-5bbb	92	9-28-78	52	.28	.12	53	14	470	11	427	0	680	89	2.0	.96	--	1.10	.094	1,587	190	--	15	2,130	7.8	14.8	58.5
19S/45E-28acb	620	9-27-78	89	.08	.04	21	1.5	52	13	158	0	48	4.0	.8	.11	--	.08	.110	309	59	--	3.0	374	7.7	28.6	83.5
19S/46E-4dba	470	10-24-78	64	--	--	100	31	63	17	305	0	240	35	.4	--	.04	.13	.045	701	380	130	1.4	980	6.9	24.0	75.0
19S/47E-17ddd	175	10-25-78	60	--	--	58	16	82	17	219	0	66	57	.6	--	.08	.14	.008	465	210	31	2.5	850	7.0	14.7	58.5
20S/39E-2cbc(s)	--	9-28-78	27	.11	0	5.0	1.4	2.7	1.4	18	0	2.3	.7	.1	.56	--	.02	.001	50	18	--	.3	52	--	11.0	52.0

1/ Analysis by the U.S. Bureau of Reclamation.

2/ Dissolved nitrate (NO_3) as NO_3.

3/ Residue at 180°C.

4/ Analysis by Oregon Department of Human Resources, Health Division.

5/ Total phosphate (PO_4).

6/ Total solids.

1 map